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This report describes hazardous waste generation and management in industrial establishments which manufacture special industry machinery, Standard Industrial Classification (SIC) 355, and office, computing and accounting machines, SIC 357. Based upon industry data available in the literature and collected during thirty-three plant surveys, land-disposed process wastes of both industries were found to fall into five process-defined categories: machine shop, heat treating, electroplating, materials coating, and foundry (includes ferrous and non-ferrous). Specific process waste types are characterized as to their chemical constituents and physical properties. Treatment and disposal technologies and attendant costs for each category of process wastes are described at three levels of technology: the most prevalent technology currently in use, best technology currently employed and technology for adequate health and environmental protection. Total process waste and hazardous constituent quantities were estimated for each of the five categories in two industries on a national level and disaggregated by EPA Regions and states.

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SECTION I

EXECUTIVE SUMMARY

INTRODUCTION

This study is an assessment of the hazardous waste management practices of the industrial establishments which manufacture special industry machinery, Standard Industrial Classification (SIC) 355, and office, computing, and accounting machines, SIC 357. It is one of a series of industrial studies initiated by the Office of Solid Waste (OSW), Hazardous Waste Management Division, of the U.S. Environmental Protection Agency (EPA). The studies have been conducted for information purposes only and not in response to a Congressional regulatory mandate. As such, the studies serve to provide EPA with: 1) an initial data base on current and projected types and quantities of industrial wastes and applicable treatment and disposal techniques along with their associated costs; 2) a data base for technical assistance activities; and 3) a background for guidelines development work.

The definition of "potentially hazardous waste" used in this study is based upon contractor investigations and the assessment of wastes generated by SIC 355 and 357 plants exclusively. This definition of potentially hazardous waste does not reflect EPA judgment since any Agency definition must be broadly applicable to a wide range of different types and combinations of wastes. Some of the criteria for a hazardous designation applied in this report made use of numerical limitations designed initially for other environmental control purposes, and all of the criteria are based entirely on information available to the contractor at this time. The reader is cautioned that the validity of these criteria for this purpose rests on many unknown or partially understood factors and that the criteria should be subject to review when mechanisms to illustrate actual effects of wastes in specified environments become available.

This report describes the SIC 355 and 357 industries in terms of plant distribution by geographic region, size, age, process, and products; analyzes the types of total and potentially hazardous wastes generated and estimates their present and projected quantities for 1977 and 1983; and discusses the various methods currently used to treat and dispose of these waste streams and those alternative methods needed to treat, dispose, or recycle each waste stream in a manner which will provide adequate health and environmental protection. The costs of both present and alternative treatment and disposal practices were estimated based on data collected during plant surveys and information published in other EPA reports [1-4, 63, 64].

These industries were chosen by OSW for in-depth study because an earlier overview study of hazardous wastes [3] identified processes used within plants in SIC 355 and 357 as sources of sludge or other process waste containing potentially hazardous constituents, such as heavy metals and cyanides. These wastes are to a large extent ultimately disposed on land, either directly or through incineration and ash disposal. This practice will increase due to the application of effluent limitations and new source performance standards pursuant to the Federal Water Pollution Control Act (FWPCA as Amended) to the liquid wastes of these industries. In order to meet the FWPCA's 1977 and 1983 requirements, treatment technologies effective in removing potentially hazardous materials must be applied to waste streams now discharged to municipal sewage treatment systems and/or navigable waters. Thus, the expectation of increased wastes for land disposal underscored the need for this study.

As on-site plant surveys of SIC 355 and 357 establishments progressed, it became apparent that:

1) the processes which generate heavy metal sludges and cyanide wastes are not in wide use in plants which manufacture special machinery and office, computing, and accounting machines; and

2) the processes in these industries which produce the largest quantities of waste — all of which fall in the general category of machining -- are essentially the same from one plant to another. As a result, the number of on-site surveys planned in these industries was curtailed to 33 plant visits, which represents less than one percent of the establishments in SIC's 355 and 357.

PROJECT METHODOLOGY

Standard Industrial Classifications (SIC) were used to develop and compare information on the subject industries, their production, and wastes. The statistical description of the industries presented in Section II was developed primarily from U.S. Bureau of the Census and U.S. Department of Commerce data [5, 6], along with Dun & Bradstreet directories and computer printouts [7,8]. Where data were not available — for example, on plants with less than 20 employees — contractor assumptions were applied. Published statistics and contractor estimates were used to project to 1983 the number of establishments, value of shipments, and number of employees. This information was used to estimate the quantities of wastes to be generated in 1977 and 1983.

The mechanism used primarily to characterize the wastes of these industries was on-site surveys of representative plants. Dun & Bradstreet listings were the initial basis for selection of plants to be visited on a random basis. Due to problems resulting from faulty or out-of-date information on individual plants and the uniformity in processes encountered, random selection was abandoned. Instead, selection of plants known to be utilizing electroplating, heat treating, or other waste-producing processes was substituted. Thirty-three onsite plant surveys were made. The surveys were distributed among the 4-digit SIC codes as shown in Table I-1.

Information obtained at the plants and in the literature was used to describe the various unit manufacturing processes employed, raw materials used, and the sources and nature of process wastes. Twenty-two waste samples from various processes were collected and analyzed in the contractor's laboratory to help determine which wastes would be considered potentially hazardous. The plant surveys also provided information on quantities of wastes generated by process and the number of production workers employed in each process area. These data were used to develop waste generation factors based upon numbers of process area production workers. By applying these waste generation factors to Census estimates of the national distribution of production workers, national quantities of potentially hazardous wastes were estimated for 1975. Using published forecasts on numbers of production workers and contractor estimates of waste generation factors, national quantities were extrapolated to 1977 and 1983. Census data on production worker distribution by state were used to estimate state and EPA Region quantity totals.

Cost data on the treatment and disposal of process wastes from the special machinery and office machines manufacturing industries were obtained during the survey visits and from other EPA-sponsored studies [63,64]. The waste quantities and treatment/disposal cost data provided in this report are estimated to be accurate within ± 30 percent.

MAJOR FINDINGS OF THE STUDY

Description of the Industries

The two three-digit industries covered by this report, SIC 355, special industry machinery, and SIC 357, office, computing, and accounting machines, account for 11 specific four-digit industry classifications, which are listed in Table I-1.

According to the 1972 Census of Manufactures, there were 4610 establishments in these industries, 3641 in SIC 355 and 969 in SIC 357. Total employment was approximately 397,600, with 189,500 and 208,100 employees in the two industries, respectively. SIC 355 and 357 facilities are located in every state, except Alaska, Idaho, West Virginia, and the District of Columbia. Over 2000 of these facilities, or 45 percent, are located in the five states of California, New York, New Jersey, Illinois, and Massachusetts.

TABLE I-1

DISTRIBUTION OF ONSITE MANUFACTURING PLANT SURVEYS

SIC	Description	No. of Plants Surveyed	Percent of Industry Plants Surveyed
355	Special Industry Machinery, except metalworking machinery		0.6
3551	Food Products Machinery	4	
3552	Textile Machinery	4	
3553	Woodworking Machinery	3	
3554	Paper Industries Machinery	4	
3555	Printing Trades Machinery	1	
3559	Special Industry Machinery, not elsewhere classified (NEC)	3	
357	Office, Computing, and Accounting Machines		1.4
3572	Typewriters	1	
3573	Electronic Computing Equipment	4	
3574	Calculating and Accounting Machines	3	
3576	Scales and Balances, except laboratory	3	
3579	Office Machines, NEC	3	
		33	

Sources: 1972 Census of Manufactures and Contractor data.

Another 1390, or 30 percent, are located in Ohio, Pennsylvania, North Carolina, Michigan, Texas, Wisconsin, Florida, and Georgia.

The age of the plants ranges from less than 10 years to more than 50 years. The largest percentage of plants in both SIC 355 and 357, 41 and 64 respectively, range from one to ten years old. This very high percentage of newer facilities in SIC 357 is due primarily to the 80 percent of newer facilities in SIC 3573, electronic computing equipment, a rapid-growth industry in the last decade due to increasing computer usage. Only four percent of the plants in both classifications are more than 50 years old, and 67 percent and 83 percent, respectively, are less than 21 years old.

The 1972 Census of Manufactures indicates that SIC 357, office machines, had a higher annual capital investment rate over the four-year period it covers than SIC 355, special industrial machinery. This is also largely influenced by the significantly higher expenditures in SIC 3573, electronic computers.

Total value of shipments for both industries increased by 115 percent from 1958 to 1972, and another increase of 110 percent is projected for the period extending from 1972 to 1983. The increases in value of shipments from 1958 to 1972 were either approximately equal to or greater than the increase in the wholesale price index for all commodities over the same time span, indicating a period of real growth.

Excluding SIC 3559, the total number of establishments in SIC 355 is projected to increase by 112, or 4.9 percent, from 1972 to 1983. The projected increase in total number of employees is 21,800, or 18.5 percent. SIC 3551, food products machinery, and SIC 3555, printing trades machinery, are projected to grow at a faster rate than the other segments of this overall classification. The projected increases for SIC 357 from 1972 to 1983 are 179 establishments, or 18 percent, and 149,300 employees, or 72 percent. This again reflects the relative growth nature of SIC 3573.

The products produced by these industries range in size from pocket-size electronic calculators to papermaking machines a city block in length. Many plants produce products represented by more than one SIC classification. In terms of facility size, there are 2723 plants with less than 20 employees in SIC 355 and 357, or 58 percent. This compares with 315 (7%) with 250 employees or more and only 54 (1%) with 1000 or more. These statistics establish that these are small-plant industries, a fact which has a very significant effect on types and quantities of wastes produced.

Waste types and quantities are related to plant size because small plants are less likely than large plants to have integrated process facilities incorporating casting, forging, electroplating, galvanizing, or heat treating. These processes have greater potential to produce more wastes per process than the machining operations which are more typical in small plants. This conclusion is supported by the Census process distribution data, as well as on-site surveys of plants in these industries undertaken during the course of this study. Table I-2 shows the distribution of the various manufacturing processes in the subject industries. The table indicates that casting and heat treating are the only waste intensive processes used in more than one percent of the plants in SIC 355 -- 3.2 and 4.4 percent respectively -- and heat treating and electroplating are the only waste intensive processes used in more than one percent of the plants in SIC 357 -- 3.7 and 4.6 percent respectively. Painting, another waste-producing operation, is more common in SIC 355, where 19.1 percent of the plants engage in this process, than in SIC 357, where only 8.9 percent have painting operations.

Waste Characterization

Thus, while virtually all common metal working processes are utilized at some stage in the manufacture of special industrial machinery and office, computing, and accounting machines, all of them are not common to SIC 355 or 357 plants. A substantial portion of the metal parts used by these industries, such as castings and forgings, are produced and finished elsewhere in plants classified in other SIC categories, such as foundries and electroplating job shops or are purchased as raw materials by plants in SIC 355 and 357. In addition, heat treating, electroplating, and similar processing requirements are frequently jobbed out to shops which engage in these practices exclusively.

Therefore, the character and quantity of the wastes generated by SIC 355 and 357 plants are a direct function of the process or processes used in any given manufacturing establishment and can vary among plants producing the same or similar products. For example, one plant making one type of equipment may engage in electroplating, machining, and structural fabrication. Another turning out the same product may job out the electroplating, and use no heat or chemical processes at all.

The major division of waste potential among the manufacturing processes used by these industries is between those processes which employ heat and/or chemicals, such as those listed above, and those which do not. This is because: (1) the more complex processes usually generate more wastes than a simple machining operation, for example; and (2) the application of heat and/or chemicals to a metal part nearly always requires treatment either before or after (or both) to protect the metal or to achieve desired properties. These cleaning or conditioning operations can produce almost as much waste as the primary process itself. Examples of processes with relatively high

TABLE I-2

DISTRIBUTION OF MANUFACTURING PROCESSES

Manufacturing Process	Number in SIC 355	Percent of SIC 355 Plants	Number in SIC 357	Percent of SIC 357 Plants
Ferrous and Nonferrous Foundry (Casting)	116	3.2	7	0.6
Forge	9	0.3	3	0.3
*Electroplating	33	0.9	53	4.6
Galvanizing	8	0.2	2	0.2
*Heat Treating	159	4.4	42	3.7
*Machine Shop (including tool & plate & structure fabrication; die shops; & stamping, blanking & forming; & assembly)	2335	65.0	639	56.1
*Painting	685	19.1	102	8.9
Plastics Molding	0	0	31	2.7

Source: 1967 Census of Manufactures, U.S. Department of Commerce.

---

*Determined by the contractor to generate potentially hazardous waste.

volumes of cleaning or conditioning related wastes are painting machine shops, and electroplating.

Many chemicals and materials may be used interchangeably in the same process application, although slight variations in process may require different chemicals or materials. Some compounds are more effective on, or conversely, completely incompatible with certain metals. In spite of the wide variety in specific substances used in manufacturing, however, most of them fall within five major classifications:

1. Oils
2. Metals and metallic compounds
3. Acids and alkalies
4. Organic solvents
5. Miscellaneous materials

The term "waste stream" is a designation given to a process waste or group of process wastes deriving from or generated by a manufacturing process within SIC 355 and 357. This usage provides a common unit for quantifying wastes collectively on a state, EPA regional, or national basis.

The waste streams in SIC 355 and 357 plants were determined to be generated by the following eleven basic processes:

Metal Casting
Metal Forging
Electroplating-Etching
Galvanizing
Heat Treating
Assembly
Machining
Plate or Structural Fabrication
Stamping, Blanking, and Forming
Coating
Plastics Molding

Each of these processes yields a distinctive combination of process wastes. In the plants visited, these wastes were quantifiable, if at all, according to process area totals, since waste segregation within process areas is not common practice. Therefore, both description and quantification of waste streams in this report are based on typical combinations of waste materials from each process area.

Any waste stream is, therefore, made up of one or more types of material. Disaggregation of waste stream quantities by types of waste material was attempted but was not justifiable in light of the data collectable from these plants except for the most common processes: machine shops and painting.

The different kinds of materials in a process waste stream could feasibly be segregated from each other and combined with a similar waste from other process areas for treatment or disposal purposes — solvents, for example. In typical plants, however, waste segregation is not generally practiced. This is because most of the plants are small (less than twenty production employees) and relatively small quantities of process wastes are generated.

Typical wastes produced by these processes are shown in Table I-3. They fall within the same five classes of materials listed above — i.e., oils, metals and metallic compounds, acids and alkalies, organic solvents, and miscellaneous materials. Any of the liquid wastes is likely to contain residues of other liquids and/or solids, and it is frequently the sludge which results from treatment of liquid wastes which comprises the waste for land disposal.

Scrap metal from SIC 355 and 357 plants usually does not become a waste because most of it, except for sweepings and some grindings, is recovered and sold for reprocessing and reuse. Unrecovered metal wastes are generated, however, and usually take two forms: (1) particulate metal generated in certain machining operations such as grinding, and (2) metal compounds in solution. The latter are generated during heat treating, electroplating, or other surface finishing treatments, and from the metal removed from workpieces during cleaning and scaling.

While machining is a relatively simple mechanical process, the cooling and cutting oils discarded account for the largest single process waste in SIC 355 and 357 plants. This is by virtue of the relative prevalence and size of machine shops and other machining operations in these industries compared to other processes.

The waste streams classified as potentially hazardous in Table I-3 either manifest one or more toxic characteristics or are flammable. No biological, radioactive, or explosive wastes are generated in SIC 355 and 357.

The toxic characteristics encountered include corrosivity/dermal irritation, bioconcentration, genetic change, and toxicity. In this case, the toxicity term denotes the range of toxic effects not included in the other manifestations. It is likely, however, that some wastes defined as potentially hazardous because of one toxic characteristic may also be capable of one or another of the these other manifestations. Wastes with flash points of 38°C (100°F)

TABLE I-3

WASTES GENERATED IN SIC 355 AND 357 PLANTS
Grouped According to Manufacturing Process

Casting

Metals and metallic compounds
Abrasive particles other than metal
Fluxes
Oil
Solvents
Plastic and Ceramic trash

Forging

Metals and metallic compounds
Abrasive particles other than metal
Oils
Acids

***Electroplating-Etching**

Metallic compounds
Solvents
Acids
Alkalies

Galvanizing

Metallic compounds
Solvents
Acids
Alkalies
Fluxes

***Heat Treating**

Metallic compounds
Oil
Salt

***Machining**

Metals
Oil
Solvents

***Plate or Structural Fabrication**

Metals
Metallic compounds (if heat treating is employed)
Solvents

***Stamping, Blanking, and Forming**

Metals
Oil

***Coating**

Paint (water- and solvent-thinned)
Solvents

Plastics Modling

Scrap plastic
Solvents
Mold release

***Assembly**

Metals
Fluxes
Oil
Solvents

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*Processes whose waste streams are considered potentially hazardous by the contractor.

(based on U.S. Department of Transportation flammability regulations) or below are considered potentially hazardous because of their flammability.

The hazard criteria used in this report are as follows:

Hazard	Criteria for Waste
Flammability	Flashpoint less than 38°C (100°F) (DOT).
Corrosivity/dermal irritation	pH less than 5.0 or greater than 9.0 [15].
Toxicity	Water leachate of a waste contains a chemical which exceeds Federal Water Quality Criteria [14]
Bioconcentration	Contains cadmium, lead, mercury, or PCB, in any detectable concentration. (Wastes were initially thought to contain these substances)
Genetic change	Contains any detectable concentrations of a known carcinogen, mutagen, or teratogen, such as trichloroethylene, arsenic or nitrates.

Any waste stream emanating from SIC 355 and 357 plants which has one or more of the following wastes or chemical characteristics is defined as potentially hazardous:

Contains oil in excess of 0.01 mg/1. A water quality standard on the order of 0.1 mg/1 is expected to be set for oil in fresh waters [65].

Contains copper, chromium, iron, and zinc dusts and grindings in excess of Federal Water Quality Criteria [14].

Contains arsenic, chromium, copper, cyanide, selenium, silver, and zinc salts in solution in excess of Federal Water Quality Criteria [14] and other criteria listed above.

Contains cadmium, lead, mercury, and PCB's in detectable concentrations.

Acidic (pH below 5)

Alkaline (pH above 9)

Flash point below 38°C (100°F)

Contains carcinogens, mutagens, or teratogens in detectable quantities.

Application of the above criteria to the wastes of these industries results in the designation of the processes shown in Table I-4 as those generating potentially hazardous waste streams.

One of the largest process waste streams, foundry wastes, were not characterized as potentially hazardous, mainly because the hazardous metals and metal salts contained in the foundry sand and sludges did not leach using water during laboratory tests (see Appendix G).

The processes considered to generate potentially hazardous wastes generally will be affected by the effluent guidelines programs -- particularly machine shop and electroplating wastes. Residues from the treatment of electroplating wastewater will increase the amount of wastes requiring some form of land disposal from the 1975 level by more than 40 percent. Additional wastes will be generated by machine shops due to oil collection through increasing use of oil/water separators by the industries.

Waste Quantities

Estimated waste quantities generated by SIC 355 and 357 plants during 1975, 1977, and 1983 are shown in Tables I-5 through I-16. Tables I-5 through I-10 present 1975, 1977, and 1983 estimated annual, national total and potentially hazardous waste quantities for SIC 355 and 357 disaggregated by waste streams and by hazardous constituents. Tables I-11 through I-16 present the 1975, 1977, and 1983 estimated annual national total and potentially hazardous waste quantities for the two industries disaggregated by states and EPA Regions where the wastes are expected to be generated. Data in these tables were developed from plant survey information and 1972 Census data. Process employee-based waste generation factors for each waste stream were also developed from plant data and used in conjunction with Census projections on production employees to extrapolate waste

TABLE I-4

DESIGNATION OF POTENTIALLY HAZARDOUS WASTE STREAMS

Process	Contains Oil	Contains Toxic Metal Compounds	Acidic or Alkaline	Low Flash Point	Contains Carcinogens, Mutagens, or Teratogens	Number of Plants in SIC 355 and 357 Using Process
	CRITERION					
Heat Treating	X	X				201
Electroplating		X	X			86
Machining	X	X		X	X	1375
Tool and Die	X	X		X	X	361
Stamping, Blanking, and Forming	X	X		X	X	450
Painting		X		X	X	787
Plate and Structural Fabrication	X	X		X	X	564
Assembly	X	X		X	X	226

TABLE I-5

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1975 National Totals
(kkg/year)

Process Waste	Total Waste[2] (Wet Wt.)	Total Waste[2] (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.): Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop[1]	79,000	50,900	79,000	50,900	18,440	3,052	1,202	—	—	27,535
Heat Treating	8,300	3,600	8,300	3,600	—	—	3,142	207	88	—
Electroplating	3,700	1,500	3,700	1,500	680	29	28	72	—	—
Coating	10,000	7,700	10,000	7,700	5,800	738	14	—	—	—
Ferrous and Non-ferrous Foundry	173,000	173,000	—	—	—	—	—	—	—	—
TOTALS	274,000	236,700	101,000	63,700	24,920	3,819	4,386	279	88	27,535

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[1] Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

[2] The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE I-6

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1977 National Totals
(kkg/year)

					Total Hazardous Constituents (Dry Wt.)					
Process Waste	Total Waste (2)		Total Potentially Hazardous Waste (2)		Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)						
Machine Shop (1)	70,000	44,700	70,000	44,700	16,500	2,664	1,080	--	--	23,865
Heat Treating	8,300	3,600	8,300	3,600	--	--	3,142	207	88	--
Electroplating	3,700	1,500	3,700	1,500	680	29	28	72	--	--
Coating	9,000	6,700	9,000	6,700	4,853	729	14	--	--	--
Ferrous and Nonferrous Foundry	161,000	161,000	--	--	--	--	--	--	--	--
TOTALS	252,000	217,500	91,000	56,500	22,033	3,422	4,264	279	88	23,865

(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE I-7

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1983 National Totals
(kkg/year)

Process Waste	Total Waste (2)		Total Potentially Hazardous Waste (2)		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	84,000	64,000	77,000	57,000	13,864	2,305	3,970	—	2	20,194
Heat Treating	13,000	9,500	9,500	6,000	—	—	5,114	165	349	—
Electroplating	8,000	5,000	4,000	2,000	630	79	418	72	—	—
Coating	13,000	11,000	9,000	7,000	3,882	638	2,035	—	4	—
Ferrous and Nonferrous Foundry	123,000	123,000	—	—	—	—	—	—	—	—
TOTALS	241,000	212,500	99,500	72,000	18,426	3,022	11,537	237	355	20,194

(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

Table I-8

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1975 National Totals
(kkg/year)

	Total Waste[2]		Total Potentially Hazardous Waste[2]		Total Hazardous Constituents (Dry Wt.)					
Process Waste	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop[1]	70,000	44,700	70,000	44,700	16,500	2,664	1,080	--	--	23,865
Heat Treating	8,300	3,600	8,300	3,600	--	--	3,142	207	88	--
Electroplating	3,700	1,500	3,700	1,500	680	29	28	72	--	--
Coating	9,000	6,700	9,000	6,700	4,853	729	14	--	--	--
Ferrous and Nonferrous Foundry	161,000	161,000	--	--	--	--	--	--	--	--
TOTALS	252,000	217,500	91,000	56,000	22,033	3,422	4,264	279	88	23,865

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(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractors estimates

TABLE I-9

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1977 National Totals
(kkg/year)

Process Waste	Total Waste(2)		Total Potentially(2) Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	39,000	25,000	39,000	25,000	8,735	1,521	600	--	--	13,769
Heat Treating	6,200	2,500	6,200	2,500	--	--	2,114	165	58	--
Electroplating	22,000	8,400	22,000	8,400	3,882	172	170	228	--	--
Coating	3,500	2,600	3,500	2,600	1,941	274	5	--	--	--
Ferrous and Nonferrous Foundry	22,000	22,000	--	--	--	--	--	--	--	--
TOTALS	92,700	60,500	70,700	38,500	14,558	1,967	2,889	393	58	13,769

(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE I-10

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1983 National Totals
(kkg/year)

	Total Waste (2)		Total Potentially Hazardous Waste (2)		Total Hazardous Constituents (Dry Wt.)					
Process Waste	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	87,000	73,000	73,000	59,000	8,735	1,661	7,003	--	4	13,769
Heat Treating	19,000	15,000	12,000	9,000	--	25	8,101	150	650	--
Electroplating	30,000	17,000	23,000	9,000	3,882	274	1,017	228	1	--
Coating	17,000	16,000	9,000	8,000	1,941	485	4,835	--	9	--
Ferrous and Nonferrous Foundry	17,000	17,000	--	--	--	--	--	--	--	--
Plastics Molding			--	--	--	--	--	--	--	--
TOTALS	153,000	138,000	117,000	85,000	14,558	2,445	20,956	378	664	13,769

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(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE I-11

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	2588.	2235.	954.	602.	235.	36.1	41.4	2.6	.8	260.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	730.	630.	269.	170.	66.	10.2	11.7	.7	.2	73.
ARKANSAS	VI	689.	596.	254.	160.	63.	9.6	11.0	.7	.2	69.
CALIFORNIA	IX	16449.	14210.	6063.	3824.	1496.	229.3	263.3	16.8	5.3	1653.
COLORADO	VIII	349.	302.	129.	81.	32.	4.9	5.6	.4	.1	35.
CONNECTICUT	I	7790.	6730.	2872.	1811.	709.	108.6	124.7	8.0	2.5	783.
DELAWARE	III	1211.	1046.	446.	282.	110.	16.9	19.4	1.2	.4	122.
FLORIDA	IV	4222.	3647.	1556.	982.	384.	58.8	67.6	4.3	1.4	424.
GEORGIA	IV	4916.	4247.	1812.	1143.	447.	68.5	78.7	5.0	1.6	494.
HAWAII	IX	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	21846.	18872.	8053.	5079.	1987.	304.5	349.7	22.3	7.0	2195.
INDIANA	V	8119.	7014.	2993.	1888.	738.	113.2	130.0	8.3	2.6	816.
IOWA	VII	3237.	2796.	1193.	753.	294.	45.1	51.8	3.3	1.0	325.
KANSAS	VII	2386.	2061.	880.	555.	217.	33.3	38.2	2.4	.8	240.
KENTUCKY	IV	1876.	1621.	691.	436.	171.	26.1	30.0	1.9	.6	189.
LOUISIANA	VI	1280.	1106.	472.	298.	116.	17.8	20.5	1.3	.4	129.
MAINE	I	963.	832.	355.	224.	88.	13.4	15.4	1.0	.3	97.
MARYLAND	III	4473.	3864.	1649.	1040.	407.	62.3	71.6	4.6	1.4	449.
MASSACHUSETTS	I	23870.	20620.	8799.	5549.	2171.	332.7	382.1	24.4	7.7	2399.
MICHIGAN	V	8907.	7695.	3283.	2071.	810.	124.1	142.6	9.1	2.9	895.
MINNESOTA	V	2384.	2060.	879.	554.	217.	33.2	38.2	2.4	.8	240.
MISSISSIPPI	IV	1289.	1114.	475.	300.	117.	18.0	20.6	1.3	.4	130.
MISSOURI	VII	1791.	1547.	660.	416.	163.	25.0	28.7	1.8	.6	180.
MONTANA	VIII	107.	93.	40.	25.	10.	1.5	1.7	.1	.0	11.
NEBRASKA	VII	289.	249.	106.	67.	26.	4.0	4.6	.3	.1	29.
NEVADA	IX	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
NEW HAMPSHIRE	I	2080.	1797.	767.	483.	189.	29.0	33.3	2.1	.7	209.
NEW JERSEY	II	16341.	14117.	6024.	3799.	1486.	227.8	261.6	16.7	5.2	1642.
NEW MEXICO	VI	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
NEW YORK	II	15755.	13610.	5807.	3663.	1433.	219.6	252.2	16.1	5.1	1583.
NORTH CAROLINA	IV	15598.	13475.	5750.	3626.	1419.	217.4	249.7	15.9	5.0	1568.
NORTH DAKOTA	VIII	190.	164.	70.	44.	17.	2.7	3.0	.2	.1	19.
OHIO	V	27351.	23627.	10082.	6358.	2488.	381.2	437.8	27.9	8.8	2749.
OKLAHOMA	VI	2415.	2087.	890.	562.	220.	33.7	38.7	2.5	.8	243.
OREGON	X	3018.	2607.	1112.	702.	274.	42.1	48.3	3.1	1.0	303.
PENNSYLVANIA	III	21996.	19002.	8108.	5114.	2001.	306.6	352.1	22.5	7.1	2210.
RHODE ISLAND	I	5623.	4858.	2073.	1307.	511.	78.4	90.0	5.7	1.8	565.
SOUTH CAROLINA	IV	11423.	9868.	4211.	2656.	1039.	159.2	182.9	11.7	3.7	1148.
SOUTH DAKOTA	VIII	190.	164.	70.	44.	17.	2.7	3.0	.2	.1	19.
TENNESSEE	IV	3597.	3108.	1326.	836.	327.	50.1	57.6	3.7	1.2	362.
TEXAS	VI	5113.	4417.	1885.	1189.	465.	71.3	81.8	5.2	1.6	514.
UTAH	VIII	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
VERMONT	I	1216.	1050.	448.	283.	111.	16.9	19.5	1.2	.4	122.
VIRGINIA	III	2297.	1984.	847.	534.	209.	32.0	36.8	2.3	.7	231.
WASHINGTON	X	4844.	4185.	1786.	1126.	441.	67.5	77.5	5.0	1.6	487.
WEST VIRGINIA	III	611.	528.	225.	142.	56.	8.5	9.8	.6	.2	61.
WISCONSIN	V	11820.	10211.	4357.	2748.	1075.	164.7	189.2	12.1	3.8	1188.
WYOMING	VIII	334.	288.	123.	78.	30.	4.6	5.3	.3	.1	34.
TOTALS		274000.	236700.	101000.	63700.	24920.	3819.0	4386.0	280.0	88.0	27535.
REGION I		41541.	35886.	15312.	9657.	3778.	579.0	665.0	42.5	13.3	4175.
II		32096.	27727.	11831.	7462.	2919.	447.4	513.8	32.8	10.3	3225.
III		30587.	26424.	11275.	7111.	2782.	426.3	489.6	31.3	9.8	3074.
IV		45510.	39314.	16775.	10580.	4139.	634.3	728.5	46.5	14.6	4573.
V		80415.	69468.	29642.	18695.	7314.	1120.8	1287.2	82.2	25.8	8081.
VI		9648.	8335.	3556.	2243.	.877.	134.5	154.4	9.9	3.1	970.
VII		7714.	6664.	2843.	1793.	702.	107.5	123.5	7.9	2.5	775.
VIII		1269.	1096.	468.	295.	115.	17.7	20.3	1.3	.4	128.
IX		17358.	14995.	6398.	4035.	1579.	241.9	277.8	17.7	5.6	1744.
X		7862.	6792.	2898.	1828.	715.	109.6	125.8	8.0	2.5	790.

TABLE I-12

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	2380.	2054.	859.	534.	208.	32.3	40.3	2.6	.8	225.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	671.	579.	242.	150.	59.	9.1	11.4	.7	.2	64.
ARKANSAS	VI	634.	547.	229.	142.	55.	8.6	10.7	.7	.2	60.
CALIFORNIA	IX	15128.	13057.	5463.	3392.	1323.	205.4	256.0	16.8	5.3	1433.
COLORADO	VIII	321.	277.	116.	72.	28.	4.4	5.4	.4	.1	30.
CONNECTICUT	I	7165.	6184.	2587.	1606.	626.	97.3	121.2	8.0	2.5	679.
DELAWARE	III	1114.	961.	402.	250.	97.	15.1	18.8	1.2	.4	105.
FLORIDA	IV	3883.	3351.	1402.	871.	339.	52.7	65.7	4.3	1.4	368.
GEORGIA	IV	4521.	3902.	1633.	1014.	395.	61.4	76.5	5.0	1.6	428.
HAWAII	IX	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	20092.	17341.	7255.	4505.	1757.	272.8	340.0	22.3	7.0	1903.
INDIANA	V	7467.	6445.	2697.	1674.	653.	101.4	126.4	8.3	2.6	707.
IOWA	VII	2977.	2569.	1075.	667.	260.	40.4	50.4	3.3	1.0	282.
KANSAS	VII	2195.	1894.	793.	492.	192.	29.8	37.1	2.4	.8	208.
KENTUCKY	IV	1725.	1489.	623.	387.	151.	23.4	29.2	1.9	.6	163.
LOUISIANA	VI	1178.	1016.	425.	264.	103.	16.0	19.9	1.3	.4	112.
MAINE	I	885.	764.	320.	198.	77.	12.0	15.0	1.0	.3	84
MARYLAND	III	4113.	3550.	1485.	922.	360.	55.9	69.6	4.6	1.4	390.
MASSACHUSETTS	I	21953.	18948.	7927.	4922.	1919.	298.1	371.5	24.4	7.7	2079.
MICHIGAN	V	8192.	7070.	2958.	1837.	716.	111.2	138.6	9.1	2.9	776.
MINNESOTA	V	2193.	1892.	792.	492.	192.	29.8	37.1	2.4	.8	208.
MISSISSIPPI	IV	1186.	1024.	428.	266.	104.	16.1	20.1	1.3	.4	112.
MISSOURI	VII	1647.	1422.	595.	369.	144.	22.4	27.9	1.8	.6	156.
MONTANA	VIII	99.	85.	36.	22.	9.	1.3	1.7	.1	.0	9.
NEBRASKA	VII	266.	229.	96.	60.	23.	3.6	4.5	.3	.1	25.
NEVADA	IX	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
NEW HAMPSHIRE	I	1913.	1651.	691.	429.	167.	26.0	32.4	2.1	.7	181.
NEW JERSEY	II	15029.	12972.	5427.	3370.	1314.	204.1	254.3	16.7	5.2	1423.
NEW MEXICO	VI	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
NEW YORK	II	14490.	12506.	5232.	3249.	1267.	196.8	245.2	16.1	5.1	1372.
NORTH CAROLINA	IV	14346.	12382.	5180.	3216.	1254.	194.8	242.7	15.9	5.0	1359.
NORTH DAKOTA	VIII	175.	151.	63.	39.	15.	2.4	3.0	.2	.1	17.
OHIO	V	25155.	21711.	9084.	5640.	2199.	341.6	425.6	27.9	8.8	2382.
OKLAHOMA	VI	2221.	1917.	802.	498.	194.	30.2	37.6	2.5	.8	210.
OREGON	X	2775.	2395.	1002.	622.	243.	37.7	47.0	3.1	1.0	263.
PENNSYLVANIA	III	20230.	17460.	7305.	4536.	1769.	274.7	342.3	22.5	7.1	1916.
RHODE ISLAND	I	5172.	4464.	1868.	1160.	452.	70.2	87.5	5.7	1.8	490.
SOUTH CAROLINA	IV	10506.	9068.	3794.	2356.	919.	142.7	177.8	11.7	3.7	995.
SOUTH DAKOTA	VIII	175.	151.	63.	39.	15.	2.4	3.0	.2	.1	17.
TENNESSEE	IV	3309.	2856.	1195.	742.	289.	44.9	56.0	3.7	1.2	313.
TEXAS	VI	4702.	4059.	1698.	1054.	411.	63.9	79.6	5.2	1.6	445.
UTAH	VIII	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
VERMONT	I	1118.	965.	404.	251.	98.	15.2	18.9	1.2	.4	106.
VIRGINIA	III	2112.	1823.	763.	474.	185.	28.7	35.7	2.3	.7	200.
WASHINGTON	X	4455.	3845.	1609.	999.	390.	60.5	75.4	5.0	1.6	422.
WEST VIRGINIA	III	562.	485.	203.	126.	49.	7.6	9.5	.6	.2	53.
WISCONSIN	V	10870.	9382.	3925.	2437.	950.	147.6	183.9	12.1	3.8	1029.
WYOMING	VIII	307.	265.	111.	69.	27.	4.2	5.2	.3	.1	29.
TOTALS		252000.	217500.	91000.	56500.	22033.	3422.0	4264.0	280.0	88.0	23865.
REGION I		38205.	32975.	13796.	8566.	3340.	518.8	646.5	42.5	13.3	3618.
II		29519.	25478.	10660.	6618.	2581.	400.9	499.5	32.8	10.3	2796.
III		28132.	24280.	10159.	6307.	2460.	382.0	476.0	31.3	9.8	2664.
IV		41856.	36125.	15115.	9384.	3660.	568.4	708.2	46.5	14.6	3964.
V		73959.	63833.	26707.	16582.	6466.	1004.3	1251.4	82.2	25.8	7004.
VI		8873.	7659.	3204.	1989.	776.	120.5	150.1	9.9	3.1	840.
VII		7095.	6123.	2562.	1591.	620.	96.3	120.0	7.9	2.5	672.
VIII		1167.	1008.	422.	262.	102.	15.9	19.8	1.3	.4	111.
IX		15964.	13778.	5765.	3579.	1396.	216.8	270.1	17.7	5.6	1512.
X		7231.	6241.	2611.	1621.	632.	98.2	122.3	8.0	2.5	685.

TABLE I-13

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1983 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.) Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	2276.	2007.	940.	680.	174.	28.5	109.0	2.2	3.4	191.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	642.	566.	265.	192.	49.	8.0	30.7	.6	.9	54.
ARKANSAS	VI	606.	535.	250.	181.	46.	7.6	29.0	.6	.9	51.
CALIFORNIA	IX	14468.	12757.	5973.	4322.	1106.	181.4	692.6	14.2	21.3	1212.
COLORADO	VIII	307.	271.	127.	92.	23.	3.9	14.7	.3	.5	26.
CONNECTICUT	I	6852.	6042.	2829.	2047.	524.	85.9	328.0	6.7	10.1	574.
DELAWARE	III	1065.	939.	440.	318.	81.	13.4	51.0	1.0	1.6	89.
FLORIDA	IV	3713.	3274.	1533.	1109.	284.	46.6	177.8	3.7	5.5	311.
GEORGIA	IV	4324.	3812.	1785.	1292.	331.	54.2	207.0	4.3	6.4	362.
HAWAII	IX	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	19215.	16943.	7933.	5741.	1469.	240.9	919.8	18.9	28.3	1610.
INDIANA	V	7141.	6297.	2948.	2134.	546.	89.5	341.9	7.0	10.5	598.
IOWA	VII	2847.	2510.	1175.	851.	218.	35.7	136.3	2.8	4.2	239.
KANSAS	VII	2099.	1851.	867.	627.	160.	26.3	100.5	2.1	3.1	176.
KENTUCKY	IV	1650.	1455.	681.	493.	126.	20.7	79.0	1.6	2.4	138.
LOUISIANA	VI	1126.	993.	465.	336.	86.	14.1	53.9	1.1	1.7	94.
MAINE	I	847.	747.	350.	253.	65.	10.6	40.5	.8	1.2	71.
MARYLAND	III	3934.	3469.	1624.	1175.	301.	49.3	188.3	3.9	5.8	330.
MASSACHUSETTS	I	20995.	18512.	8668.	6272.	1605.	263.3	1005.0	20.6	30.9	1759.
MICHIGAN	V	7834.	6908.	3235.	2341.	599.	98.2	375.0	7.7	11.5	656.
MINNESOTA	V	2097.	1849.	866.	626.	160.	26.3	100.4	2.1	3.1	176.
MISSISSIPPI	IV	1134.	1000.	468.	339.	87.	14.2	54.3	1.1	1.7	95.
MISSOURI	VII	1575.	1389.	650.	471.	120.	19.8	75.4	1.5	2.3	132.
MONTANA	VIII	95.	83.	39.	28.	7.	1.2	4.5	.1	.1	8.
NEBRASKA	VII	254.	224.	105.	76.	19.	3.2	12.2	.2	.4	21.
NEVADA	IX	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
NEW HAMPSHIRE	I	1829.	1613.	755.	546.	140.	22.9	87.6	1.8	2.7	153.
NEW JERSEY	II	14373.	12674.	5934.	4294.	1099.	180.2	688.1	14.1	21.2	1204.
NEW MEXICO	VI	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
NEW YORK	II	13857.	12219.	5721.	4140.	1059.	173.8	663.4	13.6	20.4	1161.
NORTH CAROLINA	IV	13720.	12097.	5664.	4099.	1049.	172.0	656.8	13.5	20.2	1150.
NORTH DAKOTA	VIII	167.	148.	69.	50.	13.	2.1	8.0	.2	.2	14.
OHIO	V	24056.	21212.	9932.	7187.	1839.	301.7	1151.6	23.7	35.4	2016.
OKLAHOMA	VI	2124.	1873.	877.	635.	162.	26.6	101.7	2.1	3.1	178.
OREGON	X	2654.	2340.	1096.	793.	203.	33.3	127.1	2.6	3.9	222.
PENNSYLVANIA	III	19347.	17059.	7988.	5780.	1479.	242.6	926.2	19.0	28.5	1621.
RHODE ISLAND	I	4946.	4361.	2042.	1478.	378.	62.0	236.8	4.9	7.3	414.
SOUTH CAROLINA	IV	10047.	8859.	4148.	3002.	768.	126.0	481.0	9.9	14.8	842.
SOUTH DAKOTA	VIII	167.	148.	69.	50.	13.	2.1	8.0	.2	.2	14.
TENNESSEE	IV	3164.	2790.	1306.	945.	242.	39.7	151.5	3.1	4.7	265.
TEXAS	VI	4497.	3965.	1857.	1344.	344.	56.4	215.3	4.4	6.6	377.
UTAH	VIII	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
VERMONT	I	1069.	943.	441.	319.	82.	13.4	51.2	1.1	1.6	90.
VIRGINIA	III	2020.	1781.	834.	604.	154.	25.3	96.7	2.0	3.0	169.
WASHINGTON	X	4261.	3757.	1759.	1273.	326.	53.4	204.0	4.2	6.3	357.
WEST VIRGINIA	III	538.	474.	222.	161.	41.	6.7	25.7	.5	.8	45.
WISCONSIN	V	10396.	9167.	4292.	3106.	795.	130.4	497.7	10.2	15.3	871.
WYOMING	VIII	293.	259.	121.	88.	22.	3.7	14.0	.3	.4	25.
TOTALS		241000.	212500.	99500.	72000.	18426.	3022.0	11537.0	237.0	355.0	20194.
REGION I		36538.	32217.	15085.	10916.	2794.	458.2	1749.1	35.9	53.8	3062.
II		28231.	24892.	11655.	8434.	2158.	354.0	1351.4	27.8	41.6	2366.
III		26904.	23722.	11107.	8038.	2057.	337.4	1287.9	26.5	39.6	2254.
IV		40029.	35295.	16526.	11959.	3060.	501.9	1916.2	39.4	59.0	3354.
V		70730.	62366.	29202.	21131.	5408.	886.9	3385.9	69.6	104.2	5927.
VI		8486.	7483.	3504.	2535.	649.	106.4	406.2	8.3	12.5	711.
VII		6785.	5983.	2801.	2027.	519.	85.1	324.8	6.7	10.0	569.
VIII		1116.	984.	461.	334.	85.	14.0	53.4	1.1	1.6	94.
IX		15267.	13462.	6303.	4561.	1167.	191.4	730.9	15.0	22.5	1279.
X		6915.	6097.	2855.	2066.	529.	86.7	331.0	6.8	10.2	579.

TABLE I-14

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.): Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	78.	52.	58.	32.	12.	1.6	2.4	.3	.0	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	772.	509.	576.	311.	119.	16.0	23.5	3.2	.5	112.
ARKANSAS	VI	2630.	1736.	1964.	1061.	404.	54.6	80.1	10.9	1.6	382.
CALIFORNIA	IX	16484.	10879.	12306.	6649.	2534.	342.4	502.0	68.4	10.1	2397.
COLORADO	VIII	4087.	2697.	3051.	1648.	628.	84.9	124.5	17.0	2.5	594.
CONNECTICUT	I	3864.	2550.	2885.	1559.	594.	80.3	117.7	16.0	2.4	562.
DELAWARE	III	1491.	984.	1113.	602.	229.	31.0	45.4	6.2	.9	217.
FLORIDA	IV	1851.	1221.	1382.	746.	284.	38.4	56.4	7.7	1.1	269.
GEORGIA	IV	142.	94.	106.	57.	22.	3.0	4.3	.6	.1	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	3949.	2606.	2948.	1593.	607.	82.0	120.3	16.4	2.4	574.
INDIANA	V	1950.	1287.	1456.	787.	300.	40.5	59.4	8.1	1.2	284.
IOWA	VII	102.	67.	76.	41.	16.	2.1	3.1	.4	.1	15.
KANSAS	VII	869.	573.	649.	350.	134.	18.0	26.5	3.6	.5	126.
KENTUCKY	IV	3679.	2428.	2746.	1484.	566.	76.4	112.0	15.3	2.3	535.
LOUISIANA	VI	38.	25.	29.	15.	6.	.8	1.2	.2	.0	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	[illegible]4.	386.	436.	236.	90.	12.1	17.8	2.4	.4	85.
MASSACHUSETTS	I	7724.	5098.	5767.	3116.	1187.	160.4	235.2	32.1	4.7	1123.
MICHIGAN	V	1669.	1102.	1246.	673.	257.	34.7	50.8	6.9	1.0	243.
MINNESOTA	V	[illegible]086.	4677.	5291.	2859.	1089.	147.2	215.8	29.4	4.3	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	19[illegible].	130.	147.	79.	30.	4.1	6.0	.8	.1	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	158.	104.	118.	64.	24.	3.3	4.8	.7	.1	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	737.	486.	550.	297.	113.	15.3	22.4	3.1	.5	107.
NEW JERSEY	II	3101.	2047.	2315.	1251.	477.	64.4	94.5	12.9	1.9	451.
NEW MEXICO	VI	515.	340.	384.	208.	79.	10.7	15.7	2.1	.3	75.
NEW YORK	II	12443.	8212.	9290.	5019.	1913.	258.5	378.9	51.6	7.6	1809.
NORTH CAROLINA	IV	1755.	1158.	1310.	708.	270.	36.5	53.5	7.3	1.1	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	2960.	1953.	2210.	1194.	455.	61.5	90.1	12.3	1.8	430.
OKLAHOMA	VI	1549.	1023.	1157.	625.	238.	32.2	47.2	6.4	.9	225.
OREGON	X	415.	274.	310.	167.	64.	8.6	12.6	1.7	.3	60.
PENNSYLVANIA	III	1790.	1181.	1336.	722.	275.	37.2	54.5	7.4	1.1	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	623.	411.	465.	251.	96.	12.9	19.0	2.6	.4	91.
SOUTH DAKOTA	VIII	303.	200.	226.	122.	47.	6.3	9.2	1.3	.2	44.
TENNESSEE	IV	458.	302.	342.	185.	70.	9.5	14.0	1.9	.3	67.
TEXAS	VI	4720.	3115.	3524.	1904.	726.	98.0	143.8	19.6	2.9	686.
UTAH	VIII	684.	451.	511.	276.	105.	14.2	20.8	2.8	.4	99.
VERMONT	I	174.	115.	130.	70.	27.	3.6	5.3	.7	.1	25.
VIRGINIA	III	289.	191.	216.	117.	44.	6.0	8.8	1.2	.2	42.
WASHINGTON	X	1959.	1293.	1463.	790.	301.	40.7	59.7	8.1	1.2	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	527.	348.	393.	213.	81.	10.9	16.0	2.2	.3	77.
WYOMING	VIII	293.	194.	219.	118.	45.	6.1	8.9	1.2	.2	43.
TOTALS		94700.	62500.	70700.	38200.	14558.	1967.0	2884.0	393.0	58.0	13769.
REGION I		12538.	8275.	9360.	5057.	1927.	260.4	381.8	52.0	7.7	1823.
II		15544.	10259.	11605.	6270.	2390.	322.9	473.4	64.5	9.5	2260.
III		4154.	2742.	3101.	1676.	639.	86.3	126.5	17.2	2.5	604.
IV		8586.	5667.	6410.	3464.	1320.	178.3	261.5	35.6	5.3	1248.
V		18141.	11973.	13544.	7318.	2789.	376.8	552.5	75.3	11.1	2638.
VI		7556.	4987.	5641.	3048.	1162.	156.9	230.1	31.4	4.6	1099.
VII		1325.	875.	990.	535.	204.	27.5	40.4	5.5	.8	193.
VIII		5782.	3816.	4317.	2332.	889.	120.1	176.1	24.0	3.5	841.
IX		19114.	12615.	14270.	7710.	2938.	397.0	582.1	79.3	11.7	2779.
X		1959.	1293.	1463.	790.	301.	40.7	59.7	8.1	1.2	285.

TABLE I-15

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	76.	50.	58.	32.	12.	1.6	2.4	.3	.0	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	755.	493.	576.	314.	119.	16.0	23.5	3.2	.5	112.
ARKANSAS	VI	2575.	1680.	1964.	1069.	404.	54.6	80.2	10.9	1.6	382.
CALIFORNIA	IX	16135.	10531.	12306.	6701.	2534.	342.4	502.9	68.4	10.1	2397.
COLORADO	VIII	4000.	2611.	3051.	1661.	628.	84.9	124.7	17.0	2.5	594.
CONNECTICUT	I	3783.	2469.	2885.	1571.	594.	80.3	117.9	16.0	2.4	562.
DELAWARE	III	1460.	953.	1113.	606.	229.	31.0	45.5	6.2	.9	217.
FLORIDA	IV	1812.	1182.	1382.	752.	284.	38.4	56.5	7.7	1.1	269.
GEORGIA	IV	139.	91.	106.	58.	22.	3.0	4.3	.6	.1	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	3865.	2523.	2948.	1605.	607.	82.0	120.5	16.4	2.4	574.
INDIANA	V	1909.	1246.	1456.	793.	300.	40.5	59.5	8.1	1.2	284.
IOWA	VII	99.	65.	76.	41.	16.	2.1	3.1	.4	.1	15.
KANSAS	VII	851.	555.	649.	353.	134.	18.0	26.5	3.6	.5	126.
KENTUCKY	IV	3601.	2350.	2746.	1496.	566.	76.4	112.2	15.3	2.3	535.
LOUISIANA	VI	37.	24.	29.	16.	6.	.8	1.2	.2	.0	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	572.	373.	436.	237.	90.	12.1	17.8	2.4	.4	85.
MASSACHUSETTS	I	7561.	4935.	5767.	3140.	1187.	160.4	235.6	32.1	4.7	1123.
MICHIGAN	V	1634.	1066.	1246.	679.	257.	34.7	50.9	6.9	1.0	243.
MINNESOTA	V	6937.	4527.	5291.	2881.	1089.	147.2	216.2	29.4	4.3	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	193.	126.	147.	80.	30.	4.1	6.0	.8	.1	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	155.	101.	118.	64.	24.	3.3	4.8	.7	.1	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	721.	471.	550.	300.	113.	15.3	22.5	3.1	.5	107.
NEW JERSEY	II	3036.	1981.	2315.	1261.	477.	64.4	94.6	12.9	1.9	451.
NEW MEXICO	VI	504.	329.	384.	209.	79.	10.7	15.7	2.1	.3	75.
NEW YORK	II	12180.	7949.	9290.	5059.	1913.	258.5	379.6	51.6	7.6	1809.
NORTH CAROLINA	IV	1718.	1121.	1310.	714.	270.	36.5	53.5	7.3	1.1	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	2897.	1891.	2210.	1203.	455.	61.5	90.3	12.3	1.8	430.
OKLAHOMA	VI	1517.	990.	1157.	630.	238.	32.2	47.3	6.4	.9	225.
OREGON	X	406.	265.	310.	169.	64.	8.6	12.7	1.7	.3	60.
PENNSYLVANIA	III	1752.	1143.	1336.	728.	275.	37.2	54.6	7.4	1.1	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	610.	398.	465.	253.	96.	12.9	19.0	2.6	.4	91.
SOUTH DAKOTA	VIII	297.	194.	226.	123.	47.	6.3	9.2	1.3	.2	44.
TENNESSEE	IV	449.	293.	342.	186.	70.	9.5	14.0	1.9	.3	67.
TEXAS	VI	4621.	3016.	3524.	1919.	726.	98.0	144.0	19.6	2.9	686.
UTAH	VIII	670.	437.	511.	278.	105.	14.2	20.9	2.8	.4	99.
VERMONT	I	170.	111.	130.	71.	27.	3.6	5.3	.7	.1	25.
VIRGINIA	III	283.	185.	216.	118.	44.	6.0	8.8	1.2	.2	42.
WASHINGTON	X	1918.	1252.	1463.	796.	301.	40.7	59.8	8.1	1.2	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	516.	337.	393.	214.	81.	10.9	16.1	2.2	.3	77.
WYOMING	VIII	287.	187.	219.	119.	45.	6.1	9.0	1.2	.2	43.
TOTALS		92700.	60500.	70700.	38500.	14558.	1967.0	2889.0	393.0	58.0	13769.
REGION I		12273.	8010.	9360.	5097.	1927.	260.4	382.5	52.0	7.7	1823.
II		15216.	9931.	11605.	6320.	2390.	322.9	474.2	64.5	9.5	2260.
III		4067.	2654.	3101.	1689.	639.	86.3	126.7	17.2	2.5	604.
IV		8405.	5485.	6410	3491.	1320.	178.3	261.9	35.6	5.3	1248.
V		17758.	11590.	13544.	7375.	2789.	376.8	553.4	75.3	11.1	2638.
VI		7396.	4827.	5641.	3072.	1162.	156.9	230.5	31.4	4.6	1099.
VII		1297.	847.	990.	539.	204.	27.5	40.4	5.5	.8	193.
VIII		5660.	3694.	4317.	2351.	889.	120.1	176.4	24.0	3.5	841.
IX		18710.	12211.	14270.	7771.	2938.	397.0	583.1	79.3	11.7	2779.
X		1918.	1252.	1463.	796.	301.	40.7	59.8	8.1	1.2	285.

TABLE I-16

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1983 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	126.	114.	97.	70.	12.	2.0	17.3	.3	.5	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	1247.	1124.	953.	693.	119.	19.9	170.8	3.1	5.4	112.
ARKANSAS	VI	4249.	3833.	3249.	2361.	404.	67.9	582.0	10.5	18.4	382.
CALIFORNIA	IX	26631.	24020.	20365.	14795.	2534.	425.6	3647.6	65.8	115.6	2397.
COLORADO	VIII	6602.	5955.	5049.	3668.	628.	105.5	904.3	16.3	28.7	594.
CONNECTICUT	I	6243.	5631.	4774.	3469.	594.	99.8	855.1	15.4	27.1	562.
DELAWARE	III	2409.	2173.	1842.	1338.	229.	38.5	330.0	6.0	10.5	217.
FLORIDA	IV	2990.	2697.	2286.	1661.	284.	47.8	409.5	7.4	13.0	269.
GEORGIA	IV	230.	207.	176.	128.	22.	3.7	31.5	.6	1.0	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	6379.	5754.	4878.	3544.	607.	101.9	873.8	15.8	27.7	574.
INDIANA	V	3151.	2842.	2410.	1751.	300.	50.4	431.6	7.8	13.7	284.
IOWA	VII	164.	148.	125.	91.	16.	2.6	22.5	.4	.7	15.
KANSAS	VII	1404.	1266.	1073.	780.	134.	22.4	192.3	3.5	6.1	126.
KENTUCKY	IV	5943.	5361.	4545.	3302.	566.	95.0	814.0	14.7	25.8	535.
LOUISIANA	VI	62.	56.	47.	34.	6.	1.0	8.5	.2	.3	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	944.	851.	722.	524.	90.	15.1	129.3	2.3	4.1	85.
MASSACHUSETTS	I	12480.	11256.	9543.	6933.	1187.	199.4	1709.3	30.8	54.2	1123.
MICHIGAN	V	2697.	2432.	2062.	1498.	257.	43.1	369.4	6.7	11.7	243.
MINNESOTA	V	11449.	10327.	8755.	6361.	1089.	183.0	1568.1	28.3	49.7	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	318.	287.	243.	177.	30.	5.1	43.6	.8	1.4	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	255.	230.	195.	142.	24.	4.1	35.0	.6	1.1	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	1191.	1074.	910.	661.	113.	19.0	163.1	2.9	5.2	107.
NEW JERSEY	II	5011.	4519.	3832.	2784.	477.	80.1	686.3	12.4	21.7	451.
NEW MEXICO	VI	832.	750.	636.	462.	79.	13.3	113.9	2.1	3.6	75.
NEW YORK	II	20103.	18132.	15373.	11168.	1913.	321.3	2753.5	49.7	87.2	1809.
NORTH CAROLINA	IV	2836.	2558.	2168.	1575.	270.	45.3	388.4	7.0	12.3	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	4782.	4313.	3657.	2657.	455.	76.4	655.0	11.8	20.8	430.
OKLAHOMA	VI	2503.	2258.	1914.	1391.	238.	40.0	342.9	6.2	10.9	225.
OREGON	X	670.	605.	513.	372.	64.	10.7	91.8	1.7	2.9	60.
PENNSYLVANIA	III	2892.	2608.	2211.	1607.	275.	46.2	396.1	7.1	12.5	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	1007.	708.	770.	559.	96.	16.1	137.9	2.5	4.4	91.
SOUTH DAKOTA	VIII	489.	441.	374.	272.	47.	7.8	67.0	1.2	2.1	44.
TENNESSEE	IV	740.	668.	566.	411.	70.	11.8	101.4	1.8	3.2	67.
TEXAS	VI	7626.	6878.	5832.	4237.	726.	121.9	1044.5	18.8	33.1	686.
UTAH	VIII	1105.	997.	845.	614.	105.	17.7	151.4	2.7	4.8	99.
VERMONT	I	280.	253.	214.	156.	27.	4.5	38.4	.7	1.2	25.
VIRGINIA	III	467.	421.	357.	259.	44.	7.5	64.0	1.2	2.0	42.
WASHINGTON	X	3165.	2855.	2420.	1758.	301.	50.6	433.5	7.8	13.7	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	851.	768.	651.	473.	81.	13.6	116.6	2.1	3.7	77.
WYOMING	VIII	474.	428.	362.	263.	45.	7.6	64.9	1.2	2.1	43.
TOTALS		153000.	138000.	117000.	85000.	14558.	2445.0	20956.0	378.0	664.0	13769.
REGION I		20256.	18270.	15490.	11253.	1927.	323.7	2774.4	50.0	87.9	1823.
II		25114.	22652.	19205.	13952.	2390.	401.3	3439.8	62.0	109.0	2260.
III		6712.	6054.	5133.	3729.	639.	107.3	919.3	16.6	29.1	604.
IV		13872.	12512.	10608.	7707.	1320.	221.7	1900.1	34.3	60.2	1248.
V		29310.	26436.	22413.	16283.	2789.	468.4	4014.5	72.4	127.2	2638.
VI		12208.	11011.	9335.	6782.	1162.	195.1	1672.1	30.2	53.0	1099.
VII		2141.	1931.	1638.	1190.	204.	34.2	293.3	5.3	9.3	193.
VIII		9341.	8425.	7143.	5190.	889.	149.3	1279.4	23.1	40.5	841.
IX		30880.	27853.	23614.	17156.	2938.	493.5	4229.6	76.3	134.0	2779.
X		3165.	2855.	2420.	1758.	301.	50.6	433.5	7.8	13.7	285.

quantity projections to 1977 and 1983 for SIC 355 and 357. Waste allocations to the states were based on the distribution of production employees as shown in Census data [5].

The machine shop and related machining activities account for the largest potentially hazardous waste in both SIC 355 and 357. In SIC 355, the largest hazardous waste constituent is sweepings and grindings found only in the machine shop waste stream. Up until 1983, flammable organic solvents generated in electroplating and coating as well as the machine shop will account for the largest volume waste in SIC 357. It is anticipated that oil will become the largest hazardous constituent of SIC 357 wastes in 1983 due to the impact of Federal Water Pollution Control Act requirements. Treatment of liquid wastes is estimated to increase oil quantities seven times by 1983 as SIC 357 plants move toward zero discharge of this pollutant.

Each waste stream in SIC 355, except electroplating and plastics molding, is larger in quantity than its counterpart in SIC 357. This relative distribution of waste quantities can be attributed to two factors. One is that SIC 357 employs more and larger electroplating facilities than SIC 355, and the latter has almost no plastics molding operations. Another factor is that SIC 355 products are typically much larger than SIC 357 products and processes common to both would tend to be much larger in SIC 355.

Waste quantity estimates show a decrease in both industries between 1975 and 1983. This is engendered by a general decline in SIC 355 and 357 plants, which are phasing out or reducing some production due to the prevailing economic climate. SIC 355 shows a greater decrease than SIC 357 primarily because the decline is offset somewhat by the explosive growth pattern in SIC 3573, electronic computers. SIC 3553, wood working machinery, is the only SIC 355 category which has expanded in recent years.

As shown in Tables I-11 through I-16, the states which have the most plants and production employees, based on Census data [5], are considered to have the largest quantities of process and potentially hazardous wastes. Ohio has the largest quantity of waste generated from SIC 355 manufacturing plants at approximately 27,000 kkg/yr (30,000 ton/yr) on a wet basis. Thirty-six percent of this is considered potentially hazardous. Massachusetts, Pennsylvania, Illinois, California, New Jersey, New York, North Carolina, and Wisconsin follow Ohio in terms of SIC 355 waste generation within their borders. Hawaii, Montana, Nevada, New Mexico, North Dakota, South Dakota, and Utah all have less than 187 kkg/yr (206 tons/yr) of total process wastes generated by their respective industrial operations in SIC 355.

EPA Region V has the greatest amount of total and potentially hazardous waste generated by SIC 355 plants with approximately 79,000 kkg/yr (87,000 tons/yr) on a wet basis and 28,000 kkg/yr (31,000 tons/yr) on a dry basis. Region IV, consisting of Southeastern states, has the next largest generation of potentially hazardous wastes, while Region VIII has the smallest quantity of waste generation from SIC 355.

California has the largest amount of SIC 357 potentially hazardous waste at 12,000 kkg/yr (13,000 tons/yr) on a wet weight basis. New York has the second highest total. Several states, including Alaska, Idaho, and Mississippi, are thought to have no waste generated from SIC 357 industries based on Census data [5]. EPA Region IX has the greatest quantities of total waste at 19,500 kkg/yr (21,500 ton/yr) and potentially hazardous waste at 13,500 kkg/yr (15,000 ton/yr), all of which are on a wet weight basis. Region V plants generate very close to these quantities of wastes.

Treatment and Disposal Practices

Several types of potentially hazardous wastes generated by manufacturing plants in SIC 355 and 357 are handled and treated either by the plant on-site or by contractors at an off-site location. On-site treatment will necessarily increase in the foreseeable future as the federal limitations discussed in Section III are imposed on the pollutant constituents of the liquid wastes generated by these industries.

As shown in Table I-17, the prevalent treatment and disposal practice for all potentially hazardous wastes is off-site sanitary landfilling. Between 70 and 75 percent of the plants are estimated to implement this practice. Conversely, none of the plants appear to use technology which is adequate to assure environmental and health protection. In preparing Table I-17, three levels of treatment and disposal practice for potentially hazardous wastes were used. The levels' definitions, are as follows:

Level I - The technology currently employed by typical facilities -- i.e., broad average present treatment and disposal practice.

Level II - The best technology currently employed. Identified technology at this level must represent the soundest process from an environmental and health standpoint currently in use in at least one location. Installations must be commercial scale; pilot and bench scale installations are not suitable.

Level III - The technology necessary to provide adequate health and environmental protection. Level III technology may be more or less sophisticated or may be identical with Level I or Level

TABLE I-17

LEVELS OF TREATMENT AND DISPOSAL FOR POTENTIALLY HAZARDOUS WASTES

	Level I	Level II	Level III
Machine Shop	Offsite sanitary landfill (used by 70% of plants)	Offsite recovery of waste oils with residue to sanitary landfill. Offsite sanitary landfill of swarf. used by 61% of plants)	Same as Level II, except that secured landfills are used instead of sanitary landfills. (not currently used)
Heat Treating	Offsite sanitary landfill (used by 70% of plants)	Same as Level I	Offsite secured landfill (not currently used)
Electroplating	Offsite sanitary landfill (used by 70% of plants)	Same as Level I	Sludge dewatering followed by secured landfilling (not currently used)
Coating	Offsite sanitary landfill (used by 75% of plants)	Offsite incineration with ash disposal in sanitary landfills. Separation and reclamation of solvents with still bottoms incineration followed by sanitary landfilling of ash (used by 10% of plants)	Same as Level II, except that secured landfills are used instead of sanitary landfills (not currently used)

II technology. At this level, identified technology may include pilot or bench scale processes, providing the exact stage of development is identified.

The wastes from all the machining operations of SIC 355 and 357 plants — machine shop, tool and die shop, plate and structural fabrication, and stamping, blanking, and forming -- were typically combined into one overall waste stream called the "machine shop" waste stream. The "machine shop," heat treating, electroplating, and painting waste streams are judged to be potentially hazardous waste streams. The concept of each individual process as the generator of a separate waste stream was functional -- and necessary due to the manner in which data were reported -- in developing the potential waste contribution of each process and for quantifying state, regional, and national quantities of total and potentially hazardous wastes. However, some of the process waste streams are made up of dissimilar materials which are amenable to different treatment and disposal technologies. Some of these individual wastes, such as waste solvents or oils, are generated in more than one process area and could be segregated from other waste streams for application of improved treatment and disposal technologies.

The most common treatment of coolants and cutting oils found in surveyed plants was filtering for reuse, used by practically all the plants. While some plants claimed complete or nearly complete recirculation of these fluids, varying operating conditions will probably not permit this in all cases. In some instances, spent lubricating and hydraulic oils are burned with fuel oil in the plant boiler after filtration. This practice is not practicable for some coolants and cutting oils because of high water content. Some off-site reclamation of cutting and quenching oils by contractor was also reported, but only at about ten percent of the plants.

While a few instances of both on-site and off-site reclamation of organic solvents were discovered, this practice is not as prevalent as it is in some other industries, such as the paint and coating industry.

Cyanide neutralization and other treatment processes applied to heat treating, electroplating, and other metal finishing wastes account for the bulk of the treatment which occurs on-site in SIC 355 and 357 plants. Many of these are liquid wastes, the treatment of which results in heavy metal sludges. In this context, wastewater treatment is a source of waste for land disposal. If the liquid wastes are very small in quantity or are too dilute for economic recovery of the metals they contain, they may be drummed and placed on land directly without treatment.

In some cases, acid and alkaline cleaning solutions are neutralized or diluted before discharge to a sanitary sewer.

However, some are sewered without either treatment. Concentrated residues from electroplating waste solutions such as these will be candidates for land disposal by 1983. Sewered wastes have not been included in the waste generation tables presented previously.

A wide range was found in the degree of sophistication of waste disposal practices in the surveyed plants. This appears to be largely a function of plant size and location — i.e., the small plant outside a metropolitan area is more likely to engage in more primitive disposal practices.

The degree of segregation of waste streams is also widely varied from plant to plant. This variation is also largely a function of size — i.e., more segregation occurs in large plants where reclamation and recycle are practiced when economically feasible. The waste treatment and disposal technologies identified apply to the process wastes common to SIC 355 and 357 plants. This is because no discernible differences were found in the wastes generated by each process which were due to or influenced by the characteristics of the SIC category.

Costs of Potentially Hazardous Waste Treatment and Disposal

Cost data on current waste treatment and disposal practices in the subject industries were sparse at most of the plants surveyed and much of the information collected were rough estimates by plant personnel. Data were also compiled from the literature, other EPA reports [63,64], and from contacts with four waste treatment and disposal operations specifically handling wastes from these industries.

Typical manufacturing plants in SIC 355 and 357 were defined to reflect the most common operations within these industries. Census of Manufactures' data [5] were used to establish the plant characteristics, and plant survey data were used to define treatment practices.

The cost of Level I technology for treatment and disposal of potentially hazardous wastes at a typical SIC 355 plant is estimated to be about $287/year. As shown in Table I-18, this plant is defined as a machine shop with attendant plate or structural fabrication and a painting operation with a total of 17 employees. Located in an urban area, its wastes, generated at a rate of 16.4 kkg/yr (18.1 tons/yr) on a wet basis are picked up periodically by a contractor for landfill disposal. All solid wastes are collected in one disposal container and waste oils and solvents are collected, stored, and disposed of in 208- liter (55-gal.) drums.

TABLE I-18

Typical Plant Costs for Treatment and Disposal of Potentially Hazardous Wastes, 1975 (SIC 355)

Typical Plant Characteristics

The typical plant has 17 employees and in located in an urban area in EPA Region V. The manufacturing processes are: Machine Shop, Plate & Structural Fabrication, and Paint Shop. The composition of waste derived from these processes are: dirty oil; waste solvents; sweepings and grindings. Annual waste generation rates in kkg/product employee are 1.0 (wet) and 0.6 (dry)for Machine Shop and Plate and Struotural Fabrication combined and 1.0 (wet) and 0.8 (dry) for Paint Shop Waste.

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost, $	287	344	347
Cost/kkg of Waste (1) (wet) $	18	21	21
Cost/kkg of Waste (1) (dry) $	27	32	32
Cost/yr-Production Emp., $	17	20	20

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling of all process wastes by private contractor.
Level II: (2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a sanitary landfill. Off-site sanitary landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a sanitary landfill. Incineration of paint wastes by a private contractor with ash disposal in sanitary landfills.
Level II: (2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a secured landfill. Off-site secured landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a secured landfill. Incineration of paint wastes by a private contractor with ash disposal in a secured landfill.

Notes: (1) Total process waste = total potentially hazardous wastes.
(2) Waste segregation necessary.

Source: Contractor estimates.

Level I treatment and disposal costs for a typical SIC 357 plant, as shown on Table I-19, are approximately $260/year. This plant is defined as one with a machine shop and assembly operation employing an average of 15 production personnel. Its solid wastes are also combined for disposal, and oils and solvents are drummed for pick-up by a contractor at intervals of a week to a month for deposition in a landfill.

Level II costs are $344/year for the typical SIC 355 plant and $274/year for the SIC 357 plant. These reflect reductions achieved by solvent reclamation, but do not give credit for purchase of reclaimed rather than virgin solvents.

The cost of Level III treatment and disposal would not demonstrably increase above Level II. For typical SIC 355 and 357 plants they would amount to about $347/year and $274/year, respectively.

The average costs for Level I, Level II, and Level III treatment and disposal technology for the four major classes of potentially hazardous wastes are shown in Table I-20. Using Table I-17 and the waste quantity tables presented earlier in this section, total national industry costs for potentially hazardous waste treatment and disposal were determined, and are shown in Table I-21. The total cost in SIC 355 and 357 is $2.8 million/year for Level I technology. Annual level II and Level III costs are $3.5 million and $4.6 million, respectively. These costs are not significant when compared with the total annual value of shipments in 1972 for SIC 355 and 357, which is $14.8 billion. Both Level I and Level II technology costs represent only 0.02 percent of the value of shipments, while Level III technology costs will constitute 0.03 percent of the value of shipments.

TABLE I-19

Typical Plant Costs for Treatment and Disposal of Potentially Hazardous Wastes, 1975 (SIC 357)

Typical Plant Characteristics

The typical plant has 15 employees and is located in an urban area in EPA Region IX. The manufacturing process is Machine Shop (with assembly). The composition of waste derived from this process is dirty oil; waste solvents; sweepings & grindings. Annual waste generation rates in kkg/product employee is are (wet) and 0.6 (dry).

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost, $	260	274	274
Cost/kkg of waste (1) (wet) $	18	19	19
Cost/kkg of waste (1) (dry) $	28	29	29
Cost/yr-Production Emp., $	17	18	18

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling of all process wastes by private contractor.
Level II:(2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a sanitary landfill. Off-site sanitary landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a sanitary landfill.
Level II:(2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a secured landfill. Off-site secured landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a secured landfill.

Notes: (1) Total process waste = total potentially hazardous waste.
(2) Waste segregation necessary.

Source: Contractor estimates.

Table I-20

Potentially Hazardous Waste Treatment and Disposal Costs

Process	Level I Wet	Level I Dry	Level II Wet	Level II Dry	Level III Wet	Level III Dry
	Cost, $/ddg ($/ton)(2)					
Machine Shop(1)	18 (16)	28 (25)	19 (17)	30 (27)	19 (17)	30 (27)
Electroplating:						
Heavy Metal Sludges	16 (15)	40 (38)	16 (15)	40 (38)	48 (44)	120 (110)
Acid/Alkali	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA
Heat Treating	24 (22)	59 (54)	24 (22)	59 (54)	60 (61)	146 (132)
Paint Shop	10 (9)	13 (12)	51 (46)	67 (61)	54 (49)	71 (64)

Notes (1) Includes wastes from tool and die shops; stamping, blanking, and forming operations; and plate and structural fabrication operations.

(2) The wet and dry weight factors used in deriving these waste T/D costs are approximate and may vary with given manufacturing operations.

Source: Contractor estimates.

Table I-21

Total National Costs to the SIC 355 and 357 Industries
For Potentially Hazardous Waste Disposal
(1975)

Process	Cost, $ thousand/year		
	Level I	Level II	Level III
Machine Shop	2,124	2,224	2,242
Electroplating:			
Heavy Metal Sludges	206	206	617
Acid/Alkali	--	--	141
Heat Treating	348	348	870
Paint Shop	135	688	729
Total	2,813	3,484	4,599

SECTION II

DESCRIPTION OF THE INDUSTRIES

INTRODUCTION

This section describes the two industries which manufacture special industrial machinery and office, computing, and accounting machines. The products of the two industries are identified and their Standard Industrial Classifications (SIC) are introduced. These classifications will be used to present and compare statistics describing various segments of the industries, their production, and wastes.

The number and geographic distribution of manufacturing establishments in SIC 355 and 357 are set forth and relevant statistics on number of employees, value of shipments, and new capital expenditures are presented. Size of establishments is compared using the data on number of employees.

The distribution of individual metal working processes among plants is described statistically along with the age distribution. The section closes with a discussion of product distribution which was developed from the 1972 Census of Manufactures [5]. This was also the source for the geographic and size distribution.

The process distribution is based on the 1967 Census of Manufactures [6] since this information was not provided in the 1972 Census reports. Age distribution was supplied by Dun & Bradstreet [7]. In all cases, experienced estimates were used to adjust discrepancies in the available published data.

Future trends and developments in these industries are forecast in terms of number of establishments, number of employees, and value of shipments. Both published growth factors and contractor estimates are used.

Data are given for the four-digit SIC industry codes individually within each of the three-digit codes — SIC 355 and 357. In certain instances, the data for SIC codes 3572 and 3579 are combined because they were published in this manner and there is no valid means available for segregating the information on each one. In the case of product distribution, data are presented for five-digit SIC codes within the four-digit classifications.

PRODUCTS OF THE INDUSTRIES

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Definition of the Industries

As used in this report, SIC 355 is the industrial sector which manufactures special industry machinery, except metal working machinery, whereas SIC 357 is the industrial sector which produces office, computing, and accounting machines. The four-digit SIC breakdowns for SIC's 355 and 357 are as follows:

SIC 355 - Special Industry Machinery, except metalworking machinery

- 3551 - Food Products Machinery
- 3552 - Textile Machinery
- 3553 - Woodworking Machinery
- 3554 - Paper Industries Machinery
- 3555 - Printing Trades Machinery and Equipment
- 3559 - Special Industry Machinery, Not Elsewhere Classified (N.E.C.)

SIC 357 - Office, Computing, and Accounting Machines

- 3572 - Office, Computing, and Accounting Machines
- 3573 - Electronic Computing Equipment
- 3574 - Calculating and Accounting Machines, Except Electronic Computing Equipment
- 3576 - Scales and Balances, Except Laboratory
- 3579 - Office Machines, N.E.C.

It can be seen from this list that the two three-digit, overall industry classifications account for 11 specific four-digit industry classifications. However, most of the information presented in this section combines SIC 3572 and 3579 into one classification because, as noted above, this is the way it was developed in the 1972 Census of Manufactures. It should be noted that in this report SIC 355 is often referred to as the "special machinery industry" and SIC 357 as the "office machines industry."

The magnitude of the two industries (SIC's 355 and 357) can be discerned from the following data developed from the 1972 Census of Manufactures:

Three-digit groups	2
Four-digit groups	11
Total number of establishments	4,610
Total number of employees	397,100
Total value of shipments/yr	$14,705,000,000

The following data have been developed for establishments in SIC 355 and 357 employing 20 employees or more from the 1972 Census of

Manufactures and from the Dun & Bradstreet 1975 Metalworking Directory [8]:

	1972 Census of Manufactures	Dun & Bradstreet 1975 Metalworking Directory
Number of Establishments (with 20 or more employees)	1,951	1,984
Number of Employees	369,870(1)	397,387

(1) Data developed by contractor by assuming the 2659 establishments with 1 to 19 employees would average 10 employees each and subtracting 26,590 from 397,100, the number of employees in the entire industries.

No data were available from either source concerning value of shipments for establishments with 20 employees or less.

The differences in these figures are not large, with Dun & Bradstreet reporting 33 more establishments and 26,877 more employees than the 1972 Census of Manufactures. These differences may reflect actual changes from 1972 to 1975.

Products Produced

The 1972 Census of Manufactures provides detailed listings of products produced in each of the SIC 355 and 357 industries in terms of seven-digit SIC codes. These detailed listings are shown in Appendix A and Appendix B. The major product classifications identified by six-digit SIC codes are shown in Tables II-1 and II-2.

As can be seen, there is a great variety among the many mechanical products produced by the two three-digit industries. They range in size from tiny electronic calculators to papermaking machines which may be as much as a city block in length.

ECONOMIC STRUCTURE

While these industries include some very large manufacturing companies, typical plants are relatively small. According to 1972 Census data, approximately 58 percent of 2760 of the facilities have fewer than 20 employees, while there are only 666 establishments (14 percent) with 100 employees or more.

TABLE II-1

SIC 355 - Special Industry Machinery
Major Product Classifications*

Standard Industrial Code	Industries and Major Product Groups
3551	**Food Products Machinery**
355110	Dairy and Milk Products Plant Machinery and Equipment
355122	Commercial Food Products Machinery
355127	Bakery Machinery and Equipment
355131	Meat, Poultry and Fish Packing and Processing Machinery
355132	Vegetable Fruit Packing and Processing Machinery
355133	Flour and Grain Mill Machinery
355134	Sugar Mill Machinery
355135	Other Industrial Food Products Machinery, N.E.C.**
355136	Beverage Machinery Process Equipment Except Dairy
3552	**Textile Machinery**
355211	Fiber to Fabric Textile Machinery
355212	Carding Machines
355213	Combing Machines
355214	Spinning and Twisting Frames
355215	Yarn Preparing Machines-Winding, Beaming, Warping
355216	Power Looms
355217	Knitting Machines
355218	Other Fabric Machinery, N.E.C.
355220	Parts and Attachments for Textile Machinery

*Source: 1972 Census of Manufactures

**Not Elsewhere Classified

Table II-1 - Cont'd.

Standard Industrial Code	Industries and Major Product Groups
3553	Woodworking Machinery
355311	Sawmill Equipment Except Chain Saws
355316	Sawing Machines and Chain Saws Except Saw Mill Equipment
355317	Jointers, Matchers, Molders, Shapers, Tenoners
355318	Parts, Attachments and Accessories for Woodworking Machinery
355319	Other Woodworking Machinery, N.E.C., Except Power Hand Tools
355322	Woodworking Saws, Including Home Work Shop and Service Shop
355328	Parts Attachments and Accessories for Woodworking Machinery
355329	Other Woodworking Machinery for Home Work Shops
3554	Paper Industries Machinery
355401	Wood Preparation Equipment-Barkers, Chippers, Splitters, etc.
355402	Pulp Mill Machinery, N.E.C.
355403	Paper Mill Machinery-Beaters, Jordens
355404	Paper Machines-Fourdriniers, Cylinders, Calenders, etc.
355405	Paper and Paper Board Converting Equipment
355408	Parts, Attachments and Accessories for Paper Industry Machinery
3555	Printing Trades Machinery
355511	Printing Trades Machinery
355512	Offset and Lithographic Presses
355513	Gravure Machines
355514	Other Presses
355525	Typesetting, Typecasting and Linotype Machines
355526	Electrotyping, Photoengraving and Bookbinding Machines
355527	Ink Rollers, Foundry Type Slugs, etc.
355528	Parts, Attachments and Accessories for Printing Trade Machinery
355529	Other Printing Equipment, N.E.C.

Table II-1 - Cont'd.

Standard Industrial Code	Industries and Major Product Groups
3559	Special Industry Machinery, N.E.C.
355911	Chemical Manufacturing Industries Machinery
355923	Foundry Molding Machines
355925	Blast Cleaning Equipment
355929	Other Foundry Machinery, Including Core Making Machines
355931	Plastics Compression Molding Machines
355933	Plastics Extruding Machines
355935	Plastics Injection Molding Machines
355939	Other Plastics-Working Machinery and Equipment, N.E.C.
355940	Rubber-Working Machinery, Including Mill Mixing, Extruding
355945	Tire Building Equipment, Except Molds
355947	Tire Recapping and Repairing Machinery
355949	Other Rubber-Working Machinery, N.E.C.
355951	Petroleum and Refinery Machinery Equipment
355952	Ammunition and Explosives Loading Machinery
355953	Tobacco Manufacturing and Cigar Making Machinery
355954	Clay-Working and Concrete Products Machinery and Equipment
355955	Glass and Bottle Making Machinery and Equipment
355956	Shoe Making and Repairing Machinery and Equipment
355957	Cotton Ginning Equipment
355958	Metal Cleaning, Degreasing, Finishing and Drying Machinery
355959	Other Special Industrial Machinery, N.E.C.

TABLE II-2

SIC 357 - Office, Computing and Accounting Machines Major Product Classifications*

Standard Industrial Code	Industries and Major Products Groups
3572	**Typewriters**
357201	Typewriters and Parts and Attachments
3573	**Electronic Computing Equipment**
357311	Computing Machines, Including Electronic
357312	Gun Data Computers
357313	Computer Peripheral Equipment
357314	Card Punching, Sorting and Tabulating Machines
3574	**Calculating and Accounting Machines**
357411	Bookkeeping Machines
357412	Calculating Machines
357413	Cash Registers and Parts
357414	Voting Machines
3576	**Scales and Balances Except Laboratory**
357601	Railroad and Motor Truck Scales
357602	Industrial Scales
357603	Retail and Commercial Scales
357604	Household and Personal Scales
357605	Mail Scales
357609	Other Scales, N.E.C.
3579	**Office Machines, N.E.C.****
357901	Addressing, Dictating, Duplicating, Other office Machinery

*Source: 1972 Census of Manufactures.

**Not Elsewhere Classified.

Manufacturing facilities are located in every state except Alaska, Montana, West Virginia, and the District of Columbia. Over 2000 of these facilities, 45 percent, are located in only five states as shown below. Each of these states has at least 300 establishments:

State	Number of Facilities		
	SIC 355	SIC 357	Total
California	355	226	581
New York	346	102	448
New Jersey	294	72	366
Illinois	296	55	351
Massachusetts	230	82	312
Total	1521	537	2058

Another 1390 facilities or 30 percent are located in eight states. Those states which have between 100 and 300 facilities are as follows:

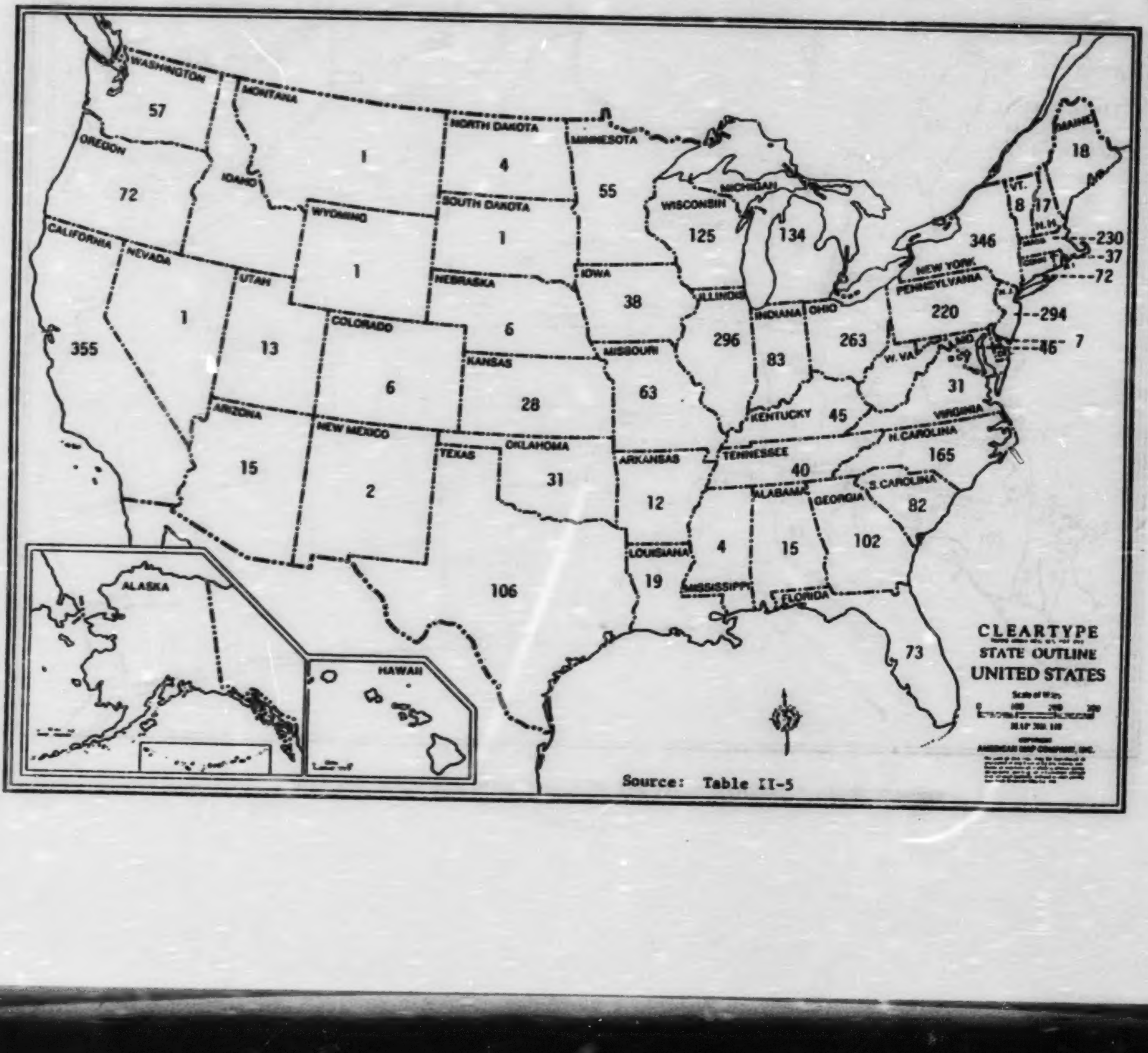
State	Number of Facilities		
	SIC 355	SIC 357	Total
Ohio	263	29	292
Pennsylvania	220	39	259
North Carolina	165	8	173
Michigan	134	33	167
Texas	106	35	141
Wisconsin	125	12	137
Florida	73	42	115
Georgia	102	4	106
Total	1188	202	1390

The geographic distributions of the above facilities are shown in Figures II-1 and II-2 along with the remaining 1190 plants (25 percent) in these industries. The latter are scattered across 34 states in numbers ranging from only one or two up to 83.

The age of plants ranges from less than 10 years to over 50 years. Based on data from the Dun & Bradstreet Listing of 6900 Manufacturing Establishments, April 1975, the following age distribution was developed for the plants in SIC's 355 and 357 [7]:

FIGURE II-1

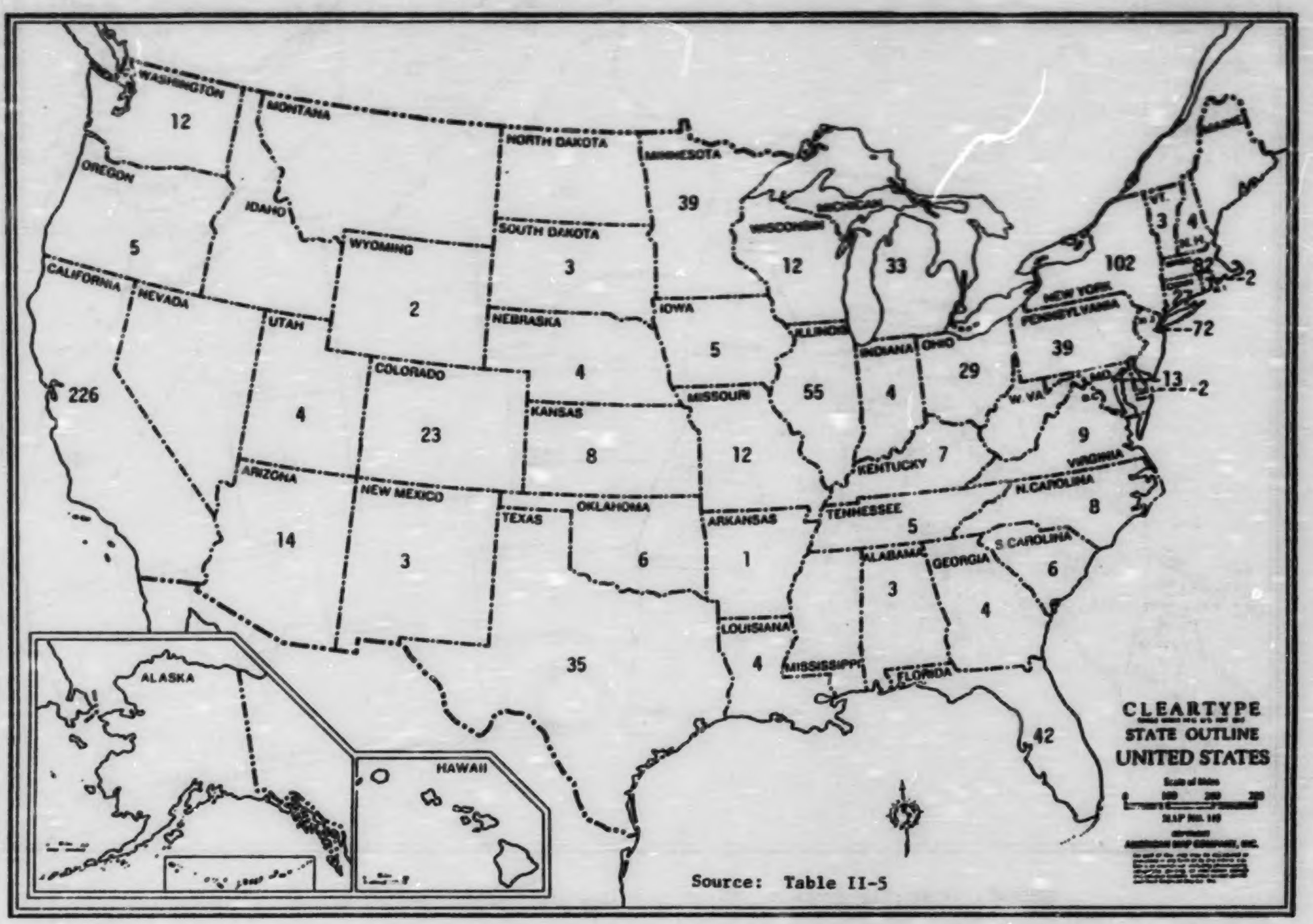
NUMBER AND GEOGRAPHIC DISTRIBUTION OF SIC 355 MANUFACTURING ESTABLISHMENTS


WASHINGTON
57
MONTANA
1
NORTH DAKOTA
4
MINNESOTA
55
OREGON
72
IDAHO
WYOMING
1
SOUTH DAKOTA
1
WISCONSIN
125
MICHIGAN
134
VT.
8
17
N.H.
MAINE
18
346
--230
--37
--72
CALIFORNIA
355
NEVADA
1
UTAH
13
NEBRASKA
6
IOWA
38
ILLINOIS
296
INDIANA
83
OHIO
263
NEW YORK
PENNSYLVANIA
220
N.J.
--294
MD
46
7
COLORADO
6
KANSAS
28
MISSOURI
63
W. VA.
31
KENTUCKY
45
VIRGINIA
ARIZONA
15
NEW MEXICO
2
TEXAS
106
OKLAHOMA
31
ARKANSAS
12
TENNESSEE
40
N. CAROLINA
165
S. CAROLINA
82
LOUISIANA
19
MISSISSIPPI
4
ALABAMA
15
GEORGIA
102
FLORIDA
73
ALASKA
HAWAII
CLEARTYPE
STATE OUTLINE
UNITED STATES
AMERICAN MAP COMPANY, INC.

Source: Table II-5

TABLE II-2

NUMBER AND GEOGRAPHIC DISTRIBUTION OF SIC 357 MANUFACTURING ESTABLISHMENTS


WASHINGTON
12
MONTANA
OREGON
5
IDAHO
CALIFORNIA
226
NEVADA
UTAH
4
WYOMING
2
NORTH DAKOTA
SOUTH DAKOTA
3
NEBRASKA
4
COLORADO
23
KANSAS
8
ARIZONA
14
NEW MEXICO
3
TEXAS
35
OKLAHOMA
6
MINNESOTA
39
IOWA
5
MISSOURI
12
ARKANSAS
1
LOUISIANA
4
WISCONSIN
12
MICHIGAN
33
ILLINOIS
55
INDIANA
4
OHIO
29
KENTUCKY
7
TENNESSEE
5
MISSISSIPPI
ALABAMA
3
GEORGIA
4
FLORIDA
42
S.CAROLINA
6
N.CAROLINA
8
VIRGINIA
9
W. VA.
MD.
D.C.
13
2
PENNSYLVANIA
39
NEW YORK
102
VT.
3
N.H.
4
82
22
2
72
ALASKA
HAWAII
CLEARTYPE
STATE OUTLINE
UNITED STATES
Scale of Miles
0 100 200 300
MAP NO. 119
AMERICAN MAP COMPANY, INC.

Source: Table II-5

Age Range (Years)	Special Machinery Industry (SIC 355)		Office Machines Industry (SIC 357)	
	No. of Plants	Percent	No. of Plants	Percent
1-10	1950	41	3044	64
11-20	1237	26	904	19
21-50	1380	29	618	13
51-Up	190	4	190	4

The very high percentage (64 percent) of newer faciliities in the office machines industry is due primarily to the 80 percent of newer facilities in SIC 3573, electronic computing equipment. It is interesting to note that only four percent of the plants in both industry groups are 51 years of age or older, and that 67 percent and 83 percent of the plants, respectively, are less than 21 years old.

Data taken from the 1972 Census of Manufactures indicate new annual capital expenditures of $450.6 million for the two industries. For the special machinery industry, this amounted to $164.0 million, or an average of $287,600 per establishment. The investment per establishment figure in the office machines industry is pushed higher by the average of $352,000 invested per establishment by the electronic computing equipment manufacturers (SIC 3573). The other subgroups invested an average of $188,500 per establishment. These data demonstrate that the office machinery industry as a whole has invested significantly more capital per establishment than has the special machinery industry.

FUTURE TRENDS AND DEVELOPMENTS

Tables II-3 and II-4 were developed to provide data for preparing Figures II-3 through II-9. Table II-3 shows trends and projections for number of establishments, number of employees, and for each of the four-digit SIC industries. Data for 1958 through 1972 were obtained from the 1967 and 1972 Census of Manufactures [5,6]; the 1974 and 1975 editions of U.S. Industry Outlook provided data for 1973 and 1974 and for compound annual shipment value growth rates, 1973 to 1980 and 1974 to 1980 [9,10]; and the compound annual growth rate in number of employees was obtained from Predicasts 1975 Annual Cumulative Edition [11]. Other compound annual growth rates shown in Table II-3 were obtained by extrapolating the graphs in Figures II-3 and II-7. There were insufficient data to support projections for SIC 3559, Special Machinery Industry, N.E.C. due to the widely varied nature of the industries in this classification, as shown in Table II-1. The projections for shipment values are in constant base year dollars, i.e., 1972, 1973, or 1974.

Table II-4 shows wholesale price indices for all commodities in 1958, 1963, 1967, 1972, 1973, and 1974. It also shows the effect of

TABLE II-3

TRENDS AND PROJECTIONS

	SIC 355 - Special Industry Machinery, Except Metalworking Machinery							SIC 357 - Office, Computing and Accounting Machines				
	SIC 3551 Food Products Machinery	SIC 3552 Textile Machinery	SIC 3553 Woodworking Machinery	SIC 3554 Paper Industries Machinery	SIC 3555 Printing Trades Machinery	SIC 3559 Special Industry Machinery, N.E.C.	SIC 355 Totals	SIC 3572 and 3579 Typewriters and Office Machines, N.E.C.	SIC 3573 Electronic Computing Equipment	SIC 3574 Calculating and Accounting Machines	SIC 3576 Scales and Balances Except Laboratory	SIC 357 Totals
A. Number of Establishments												
1958	672	553	217	202	442	1,048	3,136	138	136(1)		72	346
1963	681	561	249	217	490	1,092	3,290	182	268(1)		85	315
1967	642	560	239	220	522	1,129	3,312	202	170	130	76	394
1972	680	578	241	218	574	1,382	3,681	217	601	79	96	993
1973(2)												
1974(2)												
1977(3)	705	578	255	219	500	(4)	N.A.	217	625	135	100	1,017
1985(3)	720	578	270	218	625	(4)	N.A.	217	650	200	105	1,172
B. Number of Employees (1,000)												
1958	27.7	34.3	12.2	15.7	21.3	50.0	162.2	35.4	88.9(1)		3.3	121.6
1963	31.7	36.0	14.0	18.6	23.0	50.2	173.5	35.0	96.6(1)		3.8	137.2
1967	32.6	39.7	13.4	21.3	29.2	71.3	207.5	46.7	98.9	30.4	6.5	190.3
1972	31.9	32.7	13.5	15.3	23.9	72.2	189.5	36.4	146.6	22.6	6.5	200.1
1973	35.0	33.0	N.A.	N.A.	25.0	(4)	N.A.	35.3	160.0	40.0	N.A.	N.A.
1974	37.0	34.0	N.A.	N.A.	26.0	(4)	N.A.	N.A.	175.0	60.0	N.A.	N.A.
1977	35.1	32.4	14.2	19.9	27.5	(4)	N.A.	35.8	189.0	69.6	6.8	301.2
1985	39.2	31.9	15.1	20.6	32.3	(4)	N.A.	38.2	210.0	93.0	7.3	357.3
Compound Annual Growth Rate:												
1972-1985	1.9%	-0.2%	1.0%(5)		2.0%	(4)					1.0%(5)	
1968-1985				0.6%								
1974-1985(5)								1.0%	2.5%	5.0%		
C. Value of Shipments ($ Million)												
1958	456.2	376.3	214.4	310.2	309.0	761.1	2,420.0	302.7	1,106.2(1)		78.3	1,605.2
1963	640.5	542.7	252.8	403.9	448.4	1,015.0	3,303.3	664.6	2,019.7(1)		90.3	2,782.8
1967	830.2	711.7	356.5	351.4	752.3	1,833.0	5,035.1	1,112.0	3,770.9	707.8	160.2	5,730.9
1972	1,000.1	822.8	448.0	407.8	823.5	2,603.9	6,186.1	1,296.1	6,307.0	764.0	198.6	8,625.7
1973	1,263.0	885.0	N.A.	N.A.	870.0	N.A.	N.A.	1,350.9	7,910.0	1,200.0	N.A.	N.A.
1974	1,516.0	930.0	N.A.	N.A.	915.0	N.A.	N.A.	N.A.	9,650.0	1,920.0	N.A.	N.A.
1977	1,910.2	1,016.2	600.2	551.8	1,152.9	(4)	N.A.	1,432.7	12,836.3	3,390.4	230.4	18,156.0
1980	2,410.4	1,111.6	668.6	613.5	1,436.9	(4)	N.A.	[illegible],999.3	17,080.5	6,020.9	251.6	25,360.3
1985(6)	3,032.0	1,218.3	751.5	609.6	1,830.0	(4)	N.A.	[illegible],377.6	22,774.0	10,673.2	275.1	36,101.9
Compound Annual Growth Rate (Constant Base Year Dollars)												
1972-1980(5)			4.0%	4.0%		(4)					3.0%	
1973-1980								5.0%				
1974-1980	8.0%	3.0%			8.0%				10.0%	21.0%		

Notes:
- (1) Prior to 1967 census, SIC 3573 and 3574 were combined in SIC 3571.
- (2) Data not available on number of establishments, 1973 and 1974, for any of the four-digit SIC industries.
- (3) Data obtained from extrapolated curves, Figures 3 and 7.
- (4) Insufficient data available on which to base projections.
- (5) Estimated by contractor.
- (6) Projected at same compound growth rates as through 1980.
- N.E.C. - Not elsewhere classified.
- N.A. - Not available.

Sources: 1967 and 1972 Census of Manufactures, Years 1958-1972 except 1972 value of shipments for SIC 3574 which was taken from 1972 U.S. Industrial Outlook.
1974 and 1975 U.S. Industrial Outlook, Years 1973-1974 and compound annual growth rate, value of shipments.
Predicasts 1975 Annual Cumulative Edition, compound annual growth rate, number of employees.

Table II-4

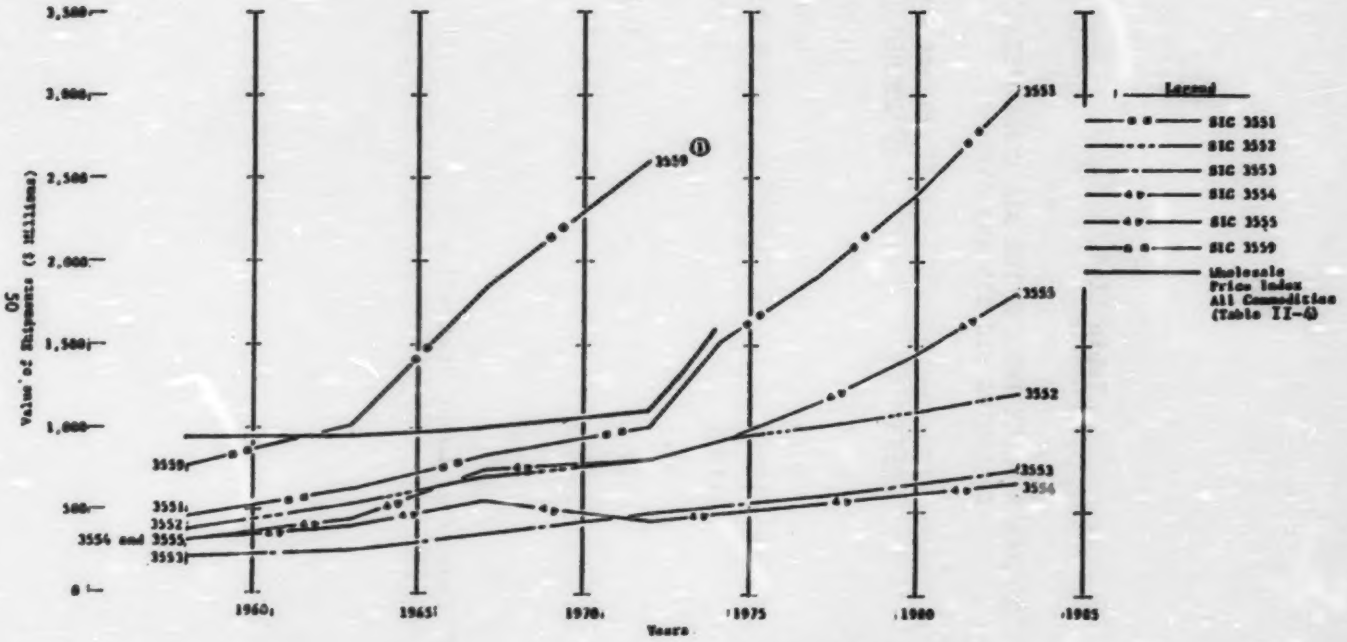
WHOLESALE PRICE INDICES FOR ALL COMMODITIES INCLUDING SIC 355 AND 357

Year	Index	Effect on Value of Shipments ($ Million)
1958	94.6	0.946
1963	94.5	0.945
1967	100.0	1.000
1972	119.1	1.191
1973	134.7	1.347
1974	160.1	.1601

Source: U.S. Bureau of Labor Statistics

FIGURE II-3

VALUE OF SHIPMENTS ($ MILLIONS)

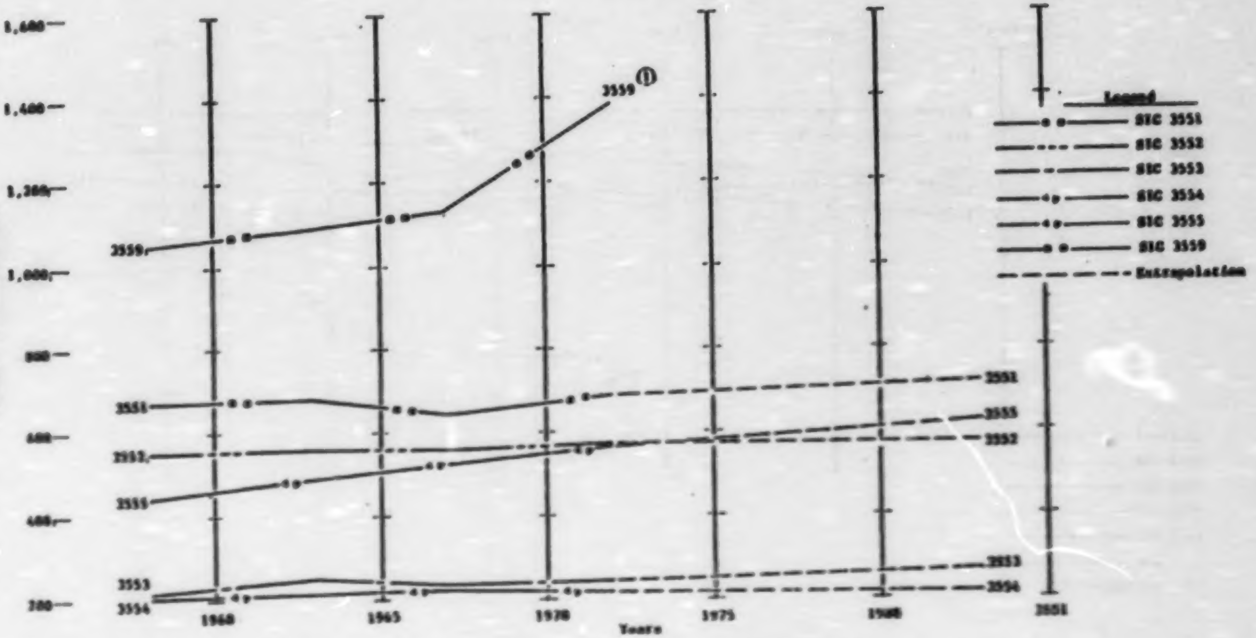


Source Tables II-3 and II-4

① No basis for extrapolation; industries in 3559 too varied

FIGURE II-4

NUMBER OF ESTABLISHMENTS
SIC 355 - SPECIAL INDUSTRY MACHINERY

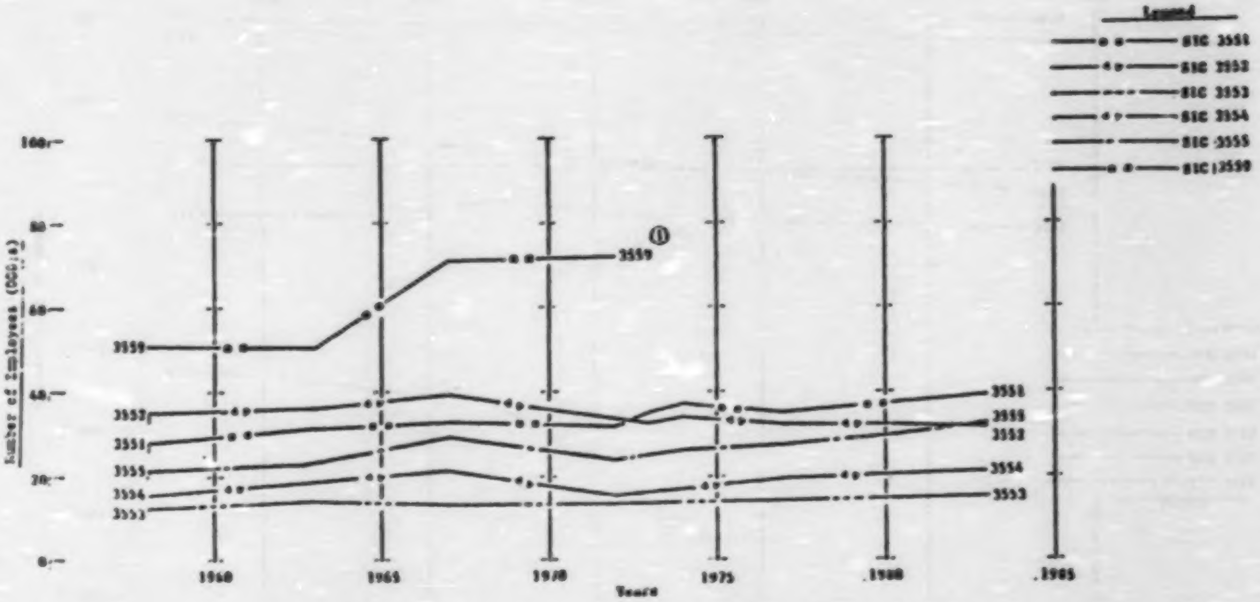


Source: Table II-3 and Contractor's extrapolation.

① No basis for extrapolation; industries in 3559 too varied

FIGURE II-5

NUMBER OF EMPLOYEES (THOUSANDS)
SIC 355 - SPECIAL MACHINERY INDUSTRY



① No basis for extrapolation; industries in 3559 too varied

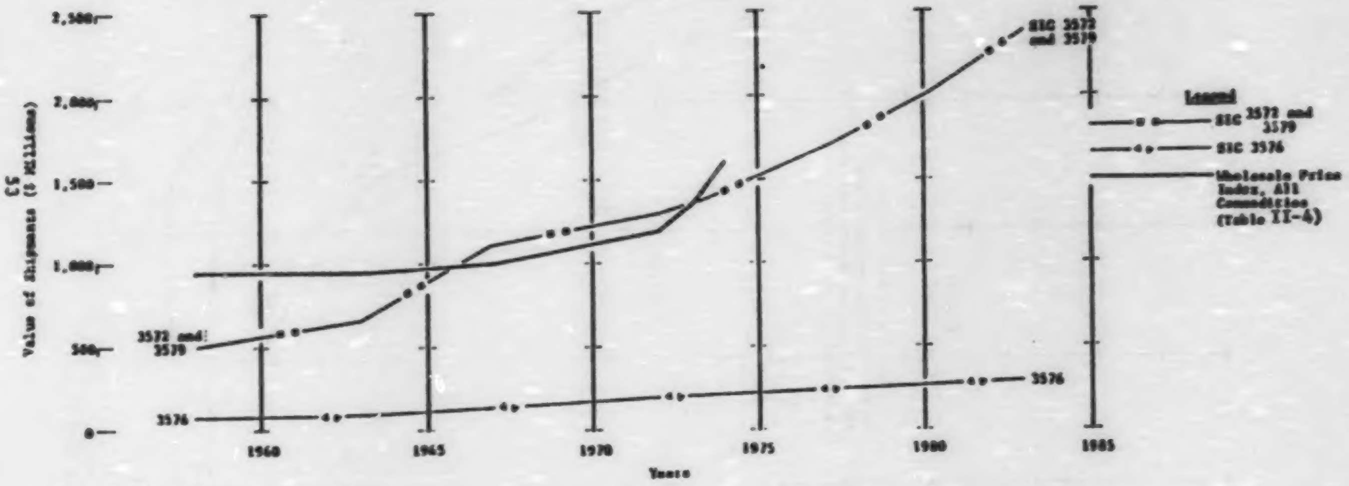
Source: Table II-3

FIGURE II-6

Value of Shipments ($ Millions)

SIC 3572 and 3579 - Typewriters and Office Machines

SIC 3576 - Scales and Balances



Sources: Tables II-3 and II-4

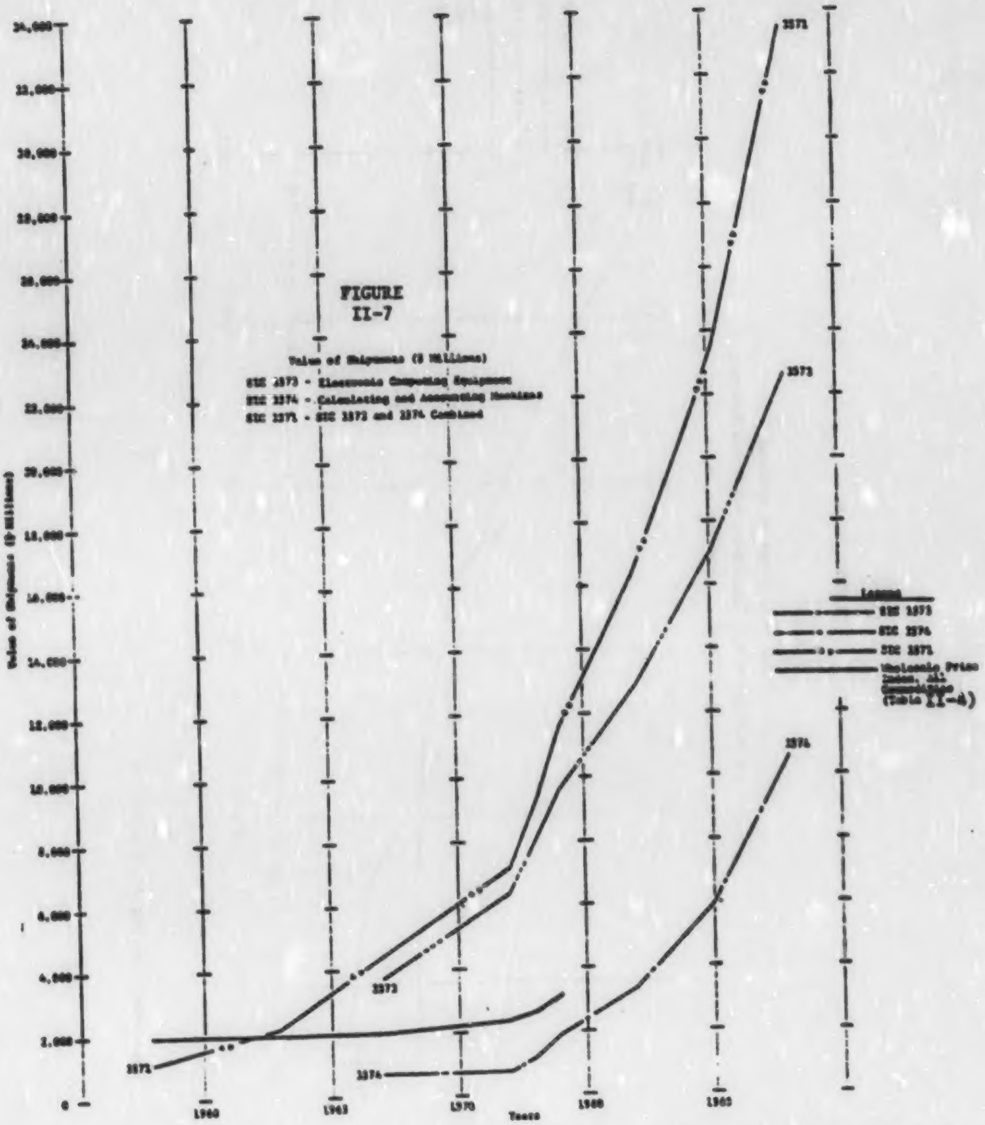
FIGURE II-7

Value of Shipments ($ Millions)

SIC 3573 - Electronic Computing Equipment

SIC 3574 - Calculating and Accounting Machines

SIC 3571 - SIC 3573 and 3574 Combined

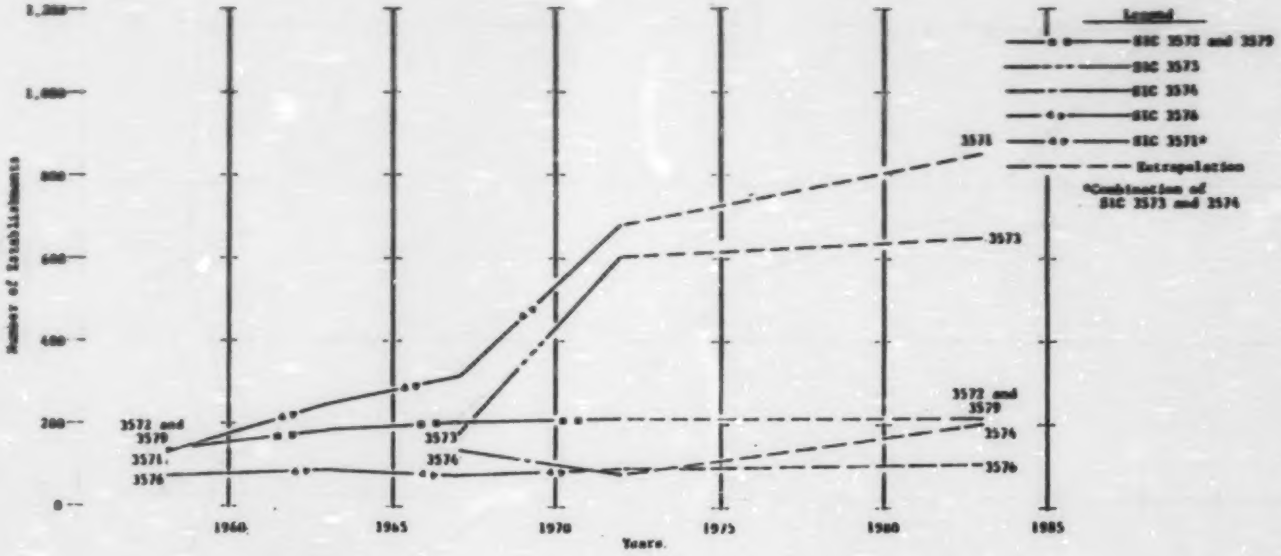


Source: Table II-3

FIGURE II-8

Number of Establishments

SIC 357 - Office, Computing and Accounting Machines



Sources: Table II-3 and Contractor's extrapolations.

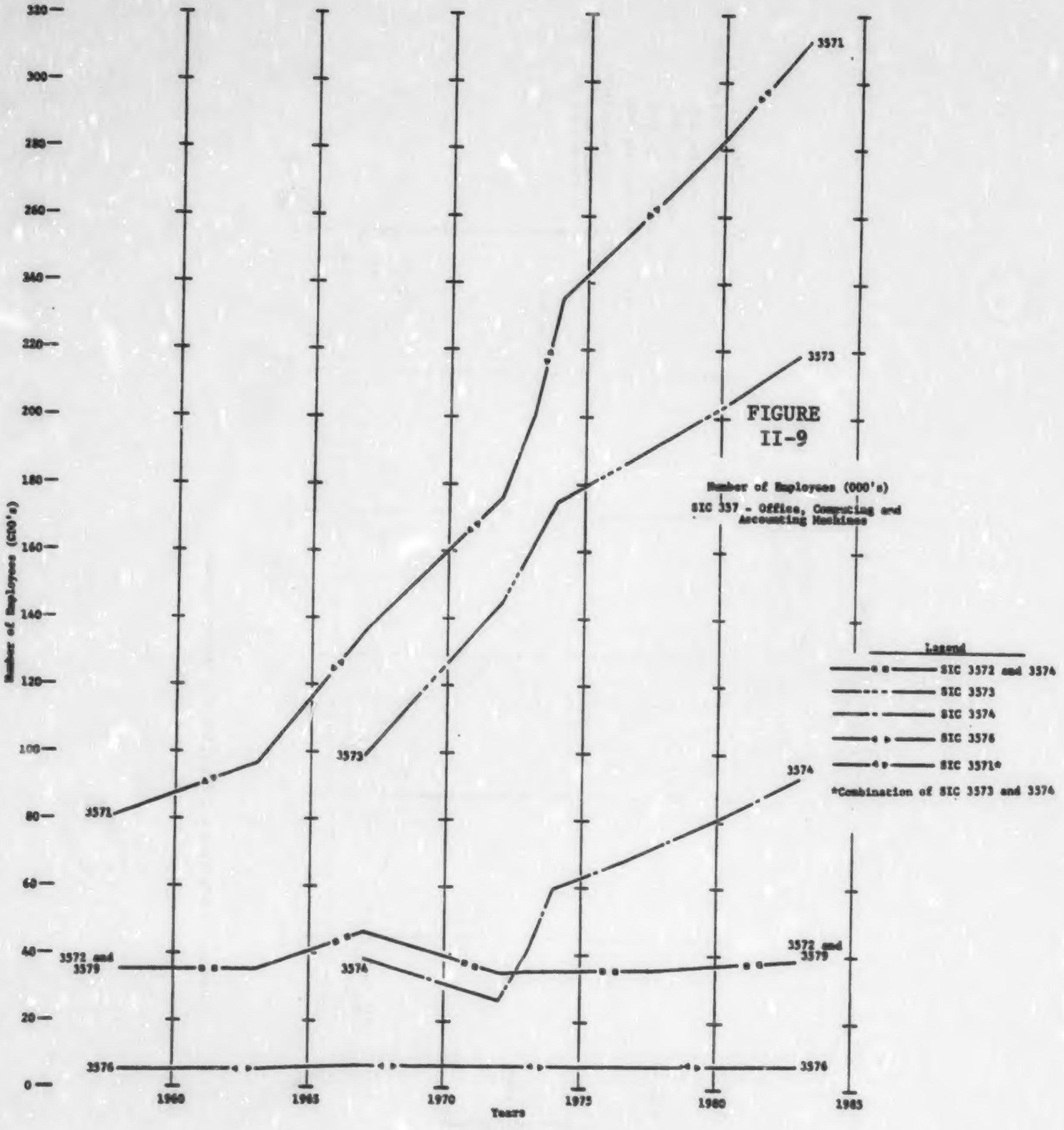


FIGURE II-9

Number of Employees (000's)

SIC 357 - Office, Computing and Accounting Machines

Source: Table II-3

that would have been worth $1.0 million dollars in 1967. The source of the indices was the 1975 Handbook of Labor Statistics [12].

Figures II-3 through II-9 graphically portray the trends and projections shown in Tables II-3 and II-4. The projections shown through 1983 could be in error in the range of plus or minus 50 percent considering the basis for their development.

The significance of the trends and projections shown in Figures II-3 through II-9 and in Table II-3 is discussed below for the individual SIC 355 and 357 industry groups.

SIC 355 - Special Machinery Industry

The value of special machinery industry shipments, not including SIC 3559, has increased for each of the four years reported in the 1972 Census of Manufactures and future increases are projected, as shown below:

Year	Shipments ($ Millions)
1958	$1,667
1963	2,288
1967	3,202
1972	3,582
1977	5,213
1983	7,521

SIC 3559 is excluded from these data because no future projections were made for it due to the diversity of products produced in this category.

Total value of shipments increased by $1.92 billion, or 115 percent, in the 14-year period from 1958 to 1972, and a further increase of $304 billion, or 110 percent, is projected for the 11-year period, 1972 to 1983. For SIC 3559 alone, value of shipments increased by $1.84 billion, or 242 percent from 1952 to 1972. The increases in value of shipments from 1958 through 1972 for each of the four-digit SIC industries in SIC 355 were either approximately equal to or considerably greater than the increase in the wholesale price index for all commodities over the same time span. This means that the increase in sales was not due solely to inflation. The indication, therefore, is that this was a period of real growth in business volume.

The compound growth rates in value of shipments have been projected as follows:

SIC	Years	Growth, Percent
3551	1974-80	8
3552	1974-80	3
3553	1972-80	4
3554	1972-80	4
3555	1974-80	8

These growth rates are in terms of constant dollars for the base year shown, i.e., either 1972 or 1974. Therefore, they indicate continuing real, though somewhat modest, growth.

Trends and projections for number of establishments and number of employees in SIC 355, Special Machinery Industry, follow generally similar patterns to those discussed for value of shipments. The actual and projected quantities, not including SIC 3559, are shown below:

Year	SIC 355 Number of Establishments	SIC 355 Number of Employees(1000)
1958	2086	111.4
1963	2198	123.3
1967	2183	136.2
1972	2299	117.3
1977	2336	129.1
1983	2411	139.1

Total number of establishments increased by 213, or 10.2 percent, from 1958 to 1972. During the same period, total number of employees increased by 5900, or 5.2 percent; this increase would have been even greater had not the total number of employees dropped between 1967 and 1972, reflecting the change in economic conditions during that time period. For SIC 3559 alone, number of establishments increased by 334 (31.9 percent) and number of employees increased by 21,400 (42.1 percent) between 1958 and 1972.

The projected increase in total number of establishments, not including SIC 3559, is 112, or 4.9 percent, from 1972 to 1983. The projected increase in total number of employees is 21,800, or 18.5 percent, for the same period. Thus, it appears that the industry as a whole will increase its total employment at a much greater rate than its number of establishments. This tends to confirm the real growth projections discussed for value of shipments.

The projected increases, 1972 to 1983, for the food products machinery and printing trades machinery industries (SIC's 3551 and 3555) amount to 75.0 percent of the increase in total number of establishments and 72.0 percent of the increase in total number of employees. The indication, therefore, is that the other four-digit SIC industries will grow at lower rates than SIC's 3551 and 3555. This finding supports the value of shipment projections.

SIC 357 - Office, Computing, and Accounting Machines

The value of office machines industry total shipments has also increased for the years reported in 1967 and 1972 Census of Manufactures, and further increases are projected as follows:

Year	Shipments ($ Millions)
1958	$1,685
1963	2,783
1967	5,731
1972	8,626
1977	18,156
1983	36,102

Total value of shipments increased by $6.94 billion, or 412 percent, in the 14-year period from 1958 to 1972, and a further increase of $27.48 billion, or 318 percent, is projected for the 11-year period, 1972 to 1983.

Each of the four-digit SIC industries within SIC 357 has contributed to these spectacular increases in total value of shipments, but in varying degrees. SIC 3576, Scales and Balances Except Laboratory, has contributed the least increase, $.12 billion from 1958 to 1972, and accounts for the smallest projected increase, $.08 billion from 1972 to 1983. SIC's 3572 and 3579, Typewriters and Office Machines, N.E.C., have made greater contributions. These two industries, which are combined in the source data, contributed increases in value of shipments amounting to $.79 billion from 1958 to 1972 and an increase of $1.08 billion is projected from 1972 to 1983.

The contributions to increases in total value of shipments made by SIC 3573, Electronic Computing Equipment, and SIC 3574, Calculating and Accounting Machines, cannot be assessed individually for the years 1958 and 1963. The reason for this is that prior to 1967, the Census of Manufactures combines these two industries in SIC 3571, Computing and Related Machines. Therefore, the contribution of

SIC 3571 to increased in total value of SIC 357 shipments must be used to provide comparability with the other four-digit SIC industries. These contributions have been unusually high, amounting to $6.03 billion from 1958 to 1972, and are projected to be $26.3 billion from 1972 and 1983.

The increases in value of shipments, 1958 through 1972, for each of the four-digit SIC industries were either approximately equal to or considerably greater than the increase in the wholesale price index for all commodities over the same time span. Future compound growth rates have been projected as follows:

SIC	Years	Growth, Percent
3572 & 3579	1973-80	5.8
3573	1974-80	10.0
3574	1974-80	21.0
3576	1972-80	3.0

These growth rates represent constant dollars for the base year shown — i.e., 1972, 1973, or 1974. They indicate continuing real growth. The projection for SIC 3574 is especially large; calculating and accounting machines have changed from electro-mechanical to electronic devices which have gained a very wide market.

Trends and projections for number of establishments and number of employees in SIC 357, Office, Computing, and Accounting Machines, follows generally similar patterns to those discussed for value of shipments. The actual and projected quantities are shown below:

Year	Number of Establishments	Number of Employees (1000)
1958	346	121.6
1963	515	137.2
1967	594	190.5
1972	993	208.1
1977	1017	301.2
1982	1172	357.3

Total number of establishments increased by 647, or 187 percent, from 1958 to 1972. During the same period, total number of employees increased by 86,500, or 71 percent. The lower rate of increase in number of employees versus the higher number of establishments may reflect improvements in productivity, in technology, and especially in electronics miniaturization which have occurred over the 14-year period.

The projected increase in total number of establishments is 179, or 18 percent, from 1972 to 1983. During the same period, the projected increase in total number of employees is 149,300, or 72 percent. This, along with the 318 percent increase in total shipments, 1972 to 1983, again reflects the overall growth nature of the SIC 357 industries.

ALPHABETIC LISTING OF PLANTS AND ADDRESSES

An alphabetic listing of all SIC 355 and 357 plants and addresses has been submitted to EPA under separate cover. This is a computer printout of information obtained from Dun & Bradstreet which is too bulky for inclusion in this report. This list will be maintained in EPA files.

Approximately the first 10 percent of the document is devoted to nonmanufacturing establishments; the balance identifies establishments which do engage in product manufacture. The listings are arranged as follows: first, in four-digit SIC code sequence; second, within each four-digit code, by alphabetic state sequence; and, third, within each state, alphabetically by company name.

NUMBER AND GEOGRAPHIC DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS

Table II-5 shows the estimated number and geographic distribution of manufacturing establishments for each of the three-digit SIC codes and their combined total numbers, and breakdowns for each of the four-digit SIC codes within them. These breakdowns are shown by state, by EPA region, and nationally.

Most of the data were derived from the 1972 Census of Manufactures. However, the Census does not show the number of plants in states having very few plants and groups several such states together as "other States." The Dun & Bradstreet Listing of all Manufacturing Establishments was used in developing estimates for those states, but only to the exact numbers shown by the Census for "other States." Thus, the column breakdowns do "add" to the national total.

As indicated previously, 75 percent or 3448 of the manufacturing establishments for SIC's 355 and 357 are located in 13 states; 45 percent (2058 plants) are in California, New York, New Jersey, Illinois, and Massachusetts. Twenty-five percent (1190 plants) are scattered in 34 states, and there are none in Alaska, Montana, and

TABLE II-5

NUMBER AND GEOGRAPHIC DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS*

		Number of establishments												
		SIC 355 - Special Industry Machinery, Except Metalworking Machinery							SIC 357 - Office, Computing and Accounting Machines					
States(1)	EPA Region	SIC 3551 Food Products Machinery	SIC 3552 Textile Machinery	SIC 3553 Woodworking Machinery	SIC 3554 Paper Industries Machinery	SIC 3555 Printing Trades Machinery	SIC 3559 Special Industry Machinery N.E.C.	SIC 355 Total	SIC 3572 and 3579 Typewriters and Office Machines	SIC 3573 Electronic Computing Equipment	SIC 3574 Calculating and Accounting Machines	SIC 3576 Scales and Balances Except Laboratory	SIC 357 Total	SIC 355 and 357 Total
Alabama	IV	0	0	3	3	0	7	13	0	3	0	0	3	16
Alaska	X	0	0	0	0	0	0	0	0	0	0	0	0	0
Arizona	IX	0	0	3	0	0	12	15	1	12	0	0	14	27
Arkansas	VI	4	0	4	0	0	4	12	0	0	1	0	1	13
California	IX	106	0	26	13	60	150	355	27	170	12	17	226	581
Colorado	VIII	4	0	2	0	0	0	6	2	17	2	2	23	29
Connecticut	I	0	9	8	3	16	36	72	10	13	4	0	27	99
Delaware	III	1	0	0	0	0	6	7	1	0	1	0	2	9
Florida	IV	21	0	4	7	12	25	73	18	20	2	0	40	113
Georgia	IV	36	61	6	5	11	54	188	6	0	0	0	6	194
Hawaii	IX	2	0	0	0	0	0	2	0	0	0	0	0	2
Idaho	X	0	0	0	0	0	1	1	0	0	0	0	0	1
Illinois	V	72	7	15	11	50	100	255	23	0	2	13	38	293
Indiana	V	18	3	10	5	7	40	83	2	0	1	1	4	87
Iowa	VII	13	5	0	0	6	19	43	1	0	0	4	5	48
Kansas	VII	12	1	0	1	6	0	20	0	6	1	1	8	28
Kentucky	IV	9	6	0	0	8	17	43	4	2	1	0	7	50
Louisiana	VI	6	0	1	1	4	6	17	2	1	1	0	4	21
Maine	I	1	2	1	3	0	10	17	0	0	0	0	0	17
Maryland	III	15	0	0	4	16	31	66	0	11	2	0	13	79
Massachusetts	I	19	65	12	14	38	71	220	12	65	5	0	82	302
Michigan	V	17	6	17	8	21	65	135	5	17	3	7	32	167
Minnesota	V	21	2	5	0	7	20	55	9	30	1	0	40	95
Mississippi	IV	0	0	3	1	0	0	4	0	0	0	0	0	4
Missouri	VII	20	2	4	0	16	21	63	3	6	1	2	12	75
Montana	VIII	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska	VII	3	1	0	0	0	0	6	1	2	1	0	4	10
Nevada	IX	0	0	0	0	0	1	1	0	0	0	0	0	1
New Hampshire	I	0	2	0	3	2	6	17	2	1	0	0	4	22
New Jersey	II	20	40	5	17	56	130	290	30	41	3	0	73	366

Table II-5 - Cont'd.

Number and Geographic Distribution of Manufacturing Establishments

Number of Establishments

States(1)	EPA Region	SIC 355 - Special Industry Machinery, Except Metalworking Machinery							SIC 357 - Office, Computing and Accounting Machines					
		SIC 3551 Food Products Machinery	SIC 3552 Textile Machinery	SIC 3553 Woodworking Machinery	SIC 3554 Paper Industries Machinery	SIC 3555 Printing Trades Machinery	SIC 3559 Special Industry Machinery N.E.C.	SIC 355 Total	SIC 3572 and 3579 Typewriters and Office Machines	SIC 3573 Electronic Computing Equipment	SIC 3574 Calculating and Accounting Machines	SIC 3576 Scales and Balances Except Laboratory	SIC 357 Total	SIC 355 and 357 Total
New Mexico	VI	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
New York	II	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
North Carolina	IV	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
North Dakota	VIII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ohio	V	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oklahoma	VI	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Oregon	X	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pennsylvania	III	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rhode Island	I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
South Carolina	IV	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
South Dakota	VIII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tennessee	IV	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Texas	VI	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Utah	VIII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Vermont	I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Virginia	III	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Washington	X	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
West Virginia	III	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wisconsin	V	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wyoming	VIII	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
National		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
EPA Region														
I		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
II		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
III		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
IV		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
V		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VI		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VII		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
VIII		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
IX		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
X		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note: Census data do not show number of plants in States having very few plants and groups as "other States"; Dun & Bradstreet data were used to develop estimates for each of the "other States." As a consequence, totals shown in this table do not agree with totals shown in Tables II-3, **-6, & II-7.

(1) None in District of Columbia.

N.E.C. - Not Elsewhere Classified

*Sources: 1972 Census of Manufactures, U.S. Department of Commerce and Dun and Bradstreet Listing of 6,900 Manufacturing Establishments, April 1974.

West Virginia, or the District of Columbia. The details of the geographic distribution in the five states which embrace 45 percent of all establishments are as follows:

California has a total of 581 establishments; 426 of these, or 73 percent, are accounted for by three four-digit SIC industries as shown below:

SIC	Industry	Percent
3551	Food Products Machinery	18
3559	Special Industry Machinery, N.E.C.	26
3573	Electronic Computing Equipment	29
		73

The fact that California has many food processing establishments and a very large aero-space industry would account for the substantial percentages of SIC 3551 and 3573 establishments. As will be seen subsequently, there is a substantial percentage of SIC 3559 establishments in all five states. The reason for this is that SIC 3559 accounts for 30 percent of the total establishments in SIC 355 and 357 combined and also it includes a great diversity of types of industry as shown in Table II-1.

New York has a total of 448 establishments; 363 of these or 81 percent are accounted for by five four-digit SIC industries as follows:

SIC	Industry	Percent
3551	Food Products Machinery	13
3552	Textile Machinery	12
3555	Printing Trades Machinery	22
3559	Special Industry Machinery, N.E.C.	22
3573	Electronic Computing Equipment	12
		81

All of these industries had their early beginnings in the Northeastern part of the United States, which accounts for their substantial percentages of New York's total number of establishments.

New Jersey has a total of 366 establishments; 285 of these, or 78 percent are accounted for by four four-digit SIC industries as follows:

SIC	Industry	Percent
3552	Textile Machinery	17
3555	Printing Trades Machinery	15
3559	Special Industry Machinery, N.E.C.	35
3573	Electronic Computing Equipment	11
		78

The primary reason for these distributions is that New Jersey, like New York, is also the area where the industries originated.

Illinois has a total of 351 establishments; 261 of these, or 74 percent, are accounted for by three four-digit industries, as shown below:

SIC	Industry	Percent
3551	Food Products Machinery	20
3552	Printing Trades Machinery	23
3559	Special Industries Machinery, N.E.C.	31
		74

Illinois is the only one of the five states which does not have a substantial percentage of SIC 3573, Electronic Computers, establishments. However, this classification does account for 5.3 percent of total SIC 357 establishments in Illinois.

Massachusetts has a total of 312 establishments; 202 of these, or 65 percent, are accounted for by three four-digit SIC industries, as follows:

SIC	Industry	Percent
3552	Textile Machinery	21
3559	Special Machinery, Industry, N.E.C.	23
3573	Electronic Computing Equipment	21
		65

The previous discussion on New York and New Jersey is also applicable to the substantial percentages of Massachusetts' total number of establishments accounted for by these three industries.

The ranking of number of establishments by EPA region is shown below:

Rank	EPA Region	Number of Establishments	Percent of Total
1	V	1128	24.6
2	II	814	17.7
3	IX	613	13.3
4	IV	601	13.1
5	I	500	10.8
6	III	367	8.0
7	VI	219	4.7
8	VII	168	3.6
9	X	147	3.1
10	VIII	53	1.1
	Totals	4610	100.0

As can be seen, EPA Regions, I, II, IV, V, and IX combined have 79.4 percent of the total establishments and II and V alone have 42.2 percent.

SIZE DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS

Table II-6 shows the distribution of manufacturing establishments in terms of number of employees per establishment. The data are shown for each of the three-digit SIC industries and their combined total and for each of the four-digit SIC industries. The ranges of number of employees identified are from 1-4, 5-9, 10-19, 20-49, 250-499, 1000-2499, and 2500 or more. This scope of ranges provides a striking contrast between plants having 1000 or more employees (only 54) and those with less than 20 employees (2733). Obviously, these are mainly small-plant industries.

These figures are particularly significant in terms of the conclusions reached in Section III. It is established in the discussion of the characteristics of the wastes of these industries that larger plants are more likely to integrate processes with a greater potential for producing hazardous wastes. However, in both three-digit SIC industries combined there are only 315 establishments with 250 or more employees, or less than seven percent of the total number of establishments.

Appendix C and Appendix D contain additional data for each of the four-digit SIC industries on the number and percentage of establishments by size in terms of the same employee ranges and in national totals. They also show the following general statistics by size range and in national totals: total number of employees; value added by manufacture; cost of materials; value of shipments; and new capital expenditures.

DISTRIBUTION OF PROCESSES IN MANUFACTURING ESTABLISHMENTS

Table II-7 shows the distribution of manufacturing processes employed in each of the three-digit industries, totals in these classifications, and breakdowns for each of the four-digit industries which they encompass. The total numbers of establishments shown are different from those in Table II-6 because Table II-6 was derived from the 1972 Census of Manufactures, while Table II-7 was derived from the 1967 Census. This was necessary because comparable 1972 process data were not available.

Some of the columns in Table II-7 exceed the total number of establishments shown. This is to be expected in all cases since many establishments utilize more than one manufacturing process. However, other discrepancies appear in the table. For example, in one

TABLE II-6

SIZE DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS*

Average Number of Employees	SIC 3551 Food Products Machinery	SIC 3552 Textile Machinery	SIC 3553 Woodworking Machinery	SIC 3554 Paper Industries Machinery	SIC 3555 Printing Trades Machinery	SIC 3559 Special Industry Machinery N.E.C.	SIC 355 Total	SIC 3572 and 3579 Typewriters and Office Machines	SIC 3573 Electronic Computing Equipment	SIC 3574 Calculating and Accounting Machines	SIC 3576 Scales and Balances Except Laboratory	SIC 357 Total	SIC 355 and 357 Total
	Number of Establishments												
	SIC 355 - Special Industry Machinery, Except Metalworking Machinery							SIC 357 - Office, Computing and Accounting Machines					
1 - 4	193	159	60	44	206	423	1,085	78	119	28	27	252	1,337
5 - 9	86	98	39	32	101	198	554	29	61	10	8	108	662
10 - 19	119	97	34	33	96	238	617	13	67	11	18	109	726
20 - 49	133	108	52	47	84	248	672	26	95	6	21	148	820
50 - 99	72	54	22	27	40	129	344	20	89	7	5	121	465
100 - 249	62	35	23	20	27	80	247	24	69	0	11	104	351
250 - 499	15	16	5	11	13	38	98	13	37	7	6	63	161
500 - 999	8	7	6	4	9	21	55	6	29	10	0	45	100
1,000 - 2,499	0	4	0	0	0	7	11	8	22	0	0	30	41
2,500 or More	0	0	0	0	0	0	0	0	13	0	0	13	13
Totals	688	578	241	218	576	1,382	3,683	217	601	79	96	993	4,676
Total 20 and Over	290	224	108	109	173	523	1,427	97	354	30	43	524	1,951

*Source: 1972 Census of Manufactures, U.S. Department of Commerce.

N.E.C. - Not Elsewhere Classified.

TABLE II-7

DISTRIBUTION OF PROCESSES IN MANUFACTURING ESTABLISHMENTS*

Manufacturing Process	Number of Establishments													
	SIC 355 - Special Industry Machinery, except Metalworking							SIC 357 - Office, Computing and Accounting Machines						
	SIC 3551 Food Products Machinery	SIC 3552 Textile Machinery	SIC 3553 Woodworking Machinery	SIC 3554 Paper Industries Machinery	SIC 3555 Printing Trades Machinery	SIC 3559 Special Industry Machinery N.E.C.	SIC 355 Total	SIC 3572 Typewriters	SIC 3573 Electronic Computing Equipment	SIC 3574 Calculating and Accounting Machines	SIC 3576 Scales and Balances Except Laboratory	SIC 3579 Office Machines	SIC 357 Total	SIC 355 and 357 Total
Total Establishments	643	360	330	230	542	1,190	[illegible]	20	130	[illegible]	30	177	[illegible]	4,720
Ferrous Foundry	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nonferrous Foundry (Except Die Casting)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Nonferrous Die Casting	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Forging-Presses, Hammers or Upsetters	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electroplating and other Plating	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Galvanizing and Other Hot-Dip Coating	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Heat Treating of Metals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Automatic Screw Machine Department	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Machine Shop	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tool and Die Shop	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Foundry Pattern Shop	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Plate or Structural Fabrication	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Stamping, Blanking and Forming of Metals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Painting, Lacquering, Enameling on Metals	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Plastics Molding	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Assembly of Product	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Shipping Department, Including Pack and Crate	0	0	0	0	0	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
All other operations such as Maintenance, Warehousing, etc.	0	0	[illegible]	0	0	0	0	0	[illegible]	0	0	0	[illegible]	[illegible]

Note: Total number of establishments shown is different than shown in Table II-3, II-5, and II-6, which is based on 1972 Census data.

N.E.C. - Not Elsewhere Classified.

*Source: 1967 Census of Manufactures, U.S. Department of Commerce. (Later data not available.)

four-digit industry the process distribution total is nearly 200 less than total establishments; in the totals for both SIC 355 and 357, the distribution of processes exactly equals the total number of establishments.

The latter situation is in conflict with the manner in which the Census of Manufactures assigns industrial classifications. If this information were correct, it would mean that plants perform only one function. In this case, they would be classified as "job shops" and placed in an SIC which covers foundries, electroplating jobbers, heat treating operations, etc. They would not be classified as establishments manufacturing SIC 355 and 357 products.

In SIC 3555, printing trades machinery, Table II-7 shows that processes used add to only 327 when they are 522 establishments listed in this category. In this instance, there are obviously insufficient processes listed to be distributed even at the rate of one to a plant, and the plant surveys showed a distinct overlap in process usage. In SIC 3554, paper industries machinery, process usage figures add to 229 when there are 220 establishments. This is also felt to be quite low in view of the degree of overlap in process use, although it is impossible to determine how low the process total actually is.

Based on the results of the plant surveys, to be discussed in detail in the next section, it appears that the reported numbers of foundries, forges, galvanizing operations, heat treatment operations, and plastics molding facilities may be more realistic. However, the numbers of machine shops, paint shops, fabrication, and assembly operations are not doubt low.

In spite of these shortcomings, however, the Census data represent the best available information on process distributions in SIC 355 and 357. In order to maintain a consistent basis, they have been used throughout the study to calculate waste generation rates.

The six most commonly used manufacturing processes are shown in the following data taken from Table II-7:

	Number of Establishments Using the Process		
Manufacturing Process	SIC 355	SIC 357	Total
Machine Shop	1201	172	1373
Printing, Lacquering, Enameling, on Metal	685	102	787
Plate or Structural Fabrication	538	26	564
Stamping, Blanking and Forming of Metals	333	117	450
Tool and Die Shop	263	98	361
Assembly of Product	0	226	226

AGE DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS

Table II-8 shows the age distribution of manufacturing establishments in the following ranges of years: 1-10, 11-20, 21-50, and 51 and over. These are age ranges for the plants themselves and do not necessarily reflect ages of machinery and equipment.

Forty-one percent of SIC 355 establishments (1,894) are ten years old or less. This age group accounts for 64 percent (663 plants) of SIC 357. Within SIC 357, SIC 3573 represents 80 percent (496 plants) of establishments ten years old or less; if SIC 3573 is excluded from the calculation for SIC 357, then establishments ten years old or less would also account for 41 percent of this classification. This further confirms the trend and growth data previously discussed concerning the rapid growth of SIC 3573 - Electronic Computing Equipment. Clearly, it is a young, high-growth industry.

In both SIC 355 and 357, only approximately four percent of the total establishments is over 50 years old. Only SIC 3572, Typewriters, has no establishments in this age category. This may be indicative of recent trends of industries moving out of cities and into more open spaces where single-floor plants can replace less efficient multi-story buildings.

Appendices E and F show more detailed information concerning age distribution of manufacturing establishments by state, EPA region, and nationally. These data are shown by four-digit SIC industries.

DISTRIBUTION OF PRODUCTS PRODUCED

Tables II-9 and II-10 show by five-digit codes within the four-digit SIC industries the products produced by the two three-digit SIC industries. These tables show shipments made in millions of dollars by the primary industry and also shipments of those same products made by other industries. The primary industry is defined as the industry which is primarily engaged in producing a specific industry product, such as SIC 3573 - Electronic Computing Equipment. However, other industries primarily engaged in producing other products may also produce products which fall under the SIC 3573 classification.

These and other industry shipments are shown in Table II-11 as percentages of the primary industry shipments.

TABLE II-8

Age Distribution of Manufacturing Establishments*

SIC Code	Industry	Number of Establishments Age Range in Years 1-10	11-20	21-50	Over 51	Total Reporting
355 Special Industry Machinery						
3551	Food Products Machinery	370	223	306	41	940
3552	Textile Machinery	263	141	198	35	637
3553	Woodworking Machinery	142	104	94	19	359
3554	Paper Industries Machinery	106	84	74	19	283
3555	Printing Trades Machinery	299	219	206	27	751
3559	Special Industry Machinery N.E.C.	714	426	489	56	1,685
	Totals, SIC 355	1,894	1,197	1,367	197	4,655
	Percent of Total Reporting	40.7%	25.7%	29.4%	4.2%	100.0%
357 Office, Computing and Accounting Machines						
3572	Typewriters	6	9	5	0	20
3573	Electronic Computing Equipment	494	77	34	9	614
3574	Calculation and Accounting Machines	26	14	10	9	59
3576	Scales and Balances, Except Laboratory	38	39	23	5	105
3579	Office Machines, N.E.C.	99	52	63	17	231
	Totals, SIC 357	663	191	135	40	1,029
	Percent of Total Reporting	64.4%	18.6%	13.1%	3.9%	100.0%
355 and 357 Combined Totals		2,557	1,388	1,502	237	5,684
	Percent of Total Reporting	44.9%	24.4%	26.5%	4.2%	100.0%

N.E.C. - Not Elsewhere Classified.

*Source: Dun & Bradstreet Listing of 6,900 Manufacturing Establishments, April 1975. Totals shown are different than those in Table II-6 because of the different data sources used.

TABLE II-9

Distribution of Products Produced by Manufacturing Establishments[a]

SIC 355 - Special Industry Machinery, Except Metalworking Machinery

Product Code	Industry, Class of Products, and Miscellaneous Receipts	All Industries	SIC 3551 Food Products Machinery	SIC 3552 Textile Machinery	SIC 3553 Wood-working Machinery	SIC 3554 Paper Industries Machinery	SIC 3555 Printing Trades Machinery	SIC 3559 Special Industry Machinery, N.E.C.	All Other Industries Value	All Other Industries Percent of Primary Industry
		Shipments, Millions of Dollars								
	Total shipments and miscellaneous receipts	N.A.	1,000.1	822.8	480.0	447.8	823.5	2,605.9	N.A.	
3551	**Food Products Machinery**	867.2	772.2	(Under 2)	(Under 2)	8.7	0	20.3	65.7	8.5
35511	Dairy and milk products plant machinery and equipment, except bottling and packaging machinery	57.4	53.1	0	0	0	0	0	4.3	8.1
35512	Commercial food products machinery, except wrapping machines	185.0	166.1	(Under 2)	(Under 2)	(Over 2)	0	2.8	[illegible]	8.1
35513	Other industrial food products machinery (except packing and bottling machinery) and parts and attachments	296.2	234.4	0	(Under 2)	(Over 2)	0	10.2	26.4	10.6
35514	Packing, packaging, and bottling machinery for industrial food products	232.1	206.0	0	0	(Under 2)	0	7.0	(Over 2)	
35510	Food products machinery, N.S.K.	96.5	94.7	0	(Under 2)	0	0	.3	(Under 2)	
3552	**Textile Machinery**	738.1	(Under 2)	709.1	(Under 2)	1.1	0	(Over 2)	23.2	3.3
35521	Textile machinery	373.8	(Under 2)	363.4	(Under 2)	(Under 2)	0	(Over 2)	5.8	1.6
35522	Parts and attachments for textile machinery	305.7	(Under 2)	287.3	0	(Under 2)	0	(Under 2)	17.2	5.9
35520	Textile machinery, N.S.K.	58.6	(Under 2)	58.4	0	0	0	0	(Under 2)	0
3553	**Woodworking Machinery**	441.6	(Under 2)	0	401.8	(Under 2)	(Under 2)	2.3	35.5	8.8
35531	Woodworking machinery (except home workshop), including parts and attachments	372.5	(Under 2)	0	335.5	(Under 2)	(Under 2)	2.3	32.7	9.7
35532	Woodworking machinery for home workshop (except power-driven handtools), including parts and attachments	51.5	0	0	49.2	0	0	0	2.3	4.7
35530	Woodworking machinery, N.S.K.	17.6	(Under 2)	0	17.1	0	0	0	(Under 2)	
3554	**Paper Industries Machinery**	381.4	(Under 2)	(Under 2)	(Under 2)	329.7	(Under 2)	27.3	22.7	6.9
3555	**Printing Trades Machinery**	738.6	(Under 2)	(Over 2)	0	8.7	670.4	(Under 2)	53.2	7.9
35551	Printing presses, lithographic	156.0	0	(Over 2)	0	(Over 2)	145.5	0	2.6	1.8
35552	Printing presses, other than lithographic	90.2	(Under 2)	0	0	(Under 2)	83.1	0	5.3	6.4
35553	Typesetting machinery and equipment	106.1	0	0	0	0	98.8	0	5.3	5.4
35554	Bindery equipment	33.5	0	0	0	0	33.5	0	0	
35555	Other printing trades machinery and equipment, parts, and attachments for all printing trades machinery and equipment	303.5	0	0	0	2.9	261.9	(Under 2)	(20-50)	7.6-19.1
35550	Printing trades machinery, N.S.K.	49.3	0	0	0	0	47.5	(Under 2)	(Under 2)	
3559	**Special Industry Machinery, N.E.C.**	2,367.1	31.2	5.6	4.4	13.3	(Under 2)	1,923.6	(200-500)	10.4-26.0
35591	Chemical manufacturing industries machinery, equipment, and parts	212.5	19.0	1.0	0	.5	0	165.3	26.7	16.2
35592	Foundry machinery and equipment	132.3	(Under 2)	(Under 2)	0	(Under 2)	0	114.8	16.2	14.1
35593	Plastics-working machinery and equipment, excluding patterns and molds	434.1	(Under 2)	(Under 2)	0	(5-10)	(Under 2)	393.9	31.7	8.0
35594	Rubber-working machinery and equipment, excluding tire molds	137.3	8.4	(Under 2)	0	(Under 2)	(Under 2)	117.3	10.6	9.0
35595	Other special industry machinery and equipment	1,281.4	3.4	3.4	4.4	4.8	(Under 2)	971.1	(200-500)	20.6-51.5
35590	Special industry machinery, N.S.K.	169.5	0	0	0	(Under 2)	0	161.1	(5-10)	3.1-6.2

[a] Source: 1972 Census of Manufactures, U.S. Department of Commerce.
N.S.K. - Not Specified by Kind.
Under 2 - Less than $2.0 million.

TABLE II-10

Distribution of Products Produced by Manufacturing Establishments*

SIC 357 - Office, Computing and Accounting Machines

Product Code	Industry, Class of Products, and Miscellaneous Receipts	Shipments, Millions of Dollars						
		All Industries	SIC 3573 Electronic Computing Equipment	SIC 3574 Calculating and Accounting Machines	SIC 3576 Scales and Balances Except Laboratory	SIC 3572 and 3579 Typewriters, and Office Machines, N.E.C.	All Other Industries	
							Value	Percent of Primary Industry
	Total Shipments and Miscellaneous Receipts	N.A.	6,387.0	637.2	198.6	1,296.1	N.A.	
3573	Electronic Computing Equipment	6,108.0	5,568.3	(20-50)	0	- (1)	498.7	9.0
35731	Electronic computers, except typewriters, peripheral equipment, and parts	1,884.3	1,680.2	(Under 2)	0	(Under 2)	203.9	12.1
35732	Peripheral equipment for electronic computers	2,745.3	2,582.3	(Over 2)	0	(Over 2)	138.3	5.3
35733	Parts and attachments for electronic computing equipment	1,403.2	1,270.6	(Over 2)	0	(Over 2)	116.5	9.2
35730	Electronic computing equipment, N.E.C.	75.2	35.[illegible]	0	0	0	40.0	113.9
3574	Calculating and Accounting Machines	694.2	(Over 2)	594.6	(Over 2)	(Over 2)	54.9	19.2
35741	Adding and calculating machines, except electronic	457.4(2)	19.2(2)	404.5(2)	(Over 2)(2)	(Over 2)(2)	28.1	6.9
35742	Electronic calculating machines	225.8	(Over 2)	178.1	0	(Over 2)	26.8	15.0
35743	Accounting machines and cash registers	- (2)	- (2)	- (2)	- (2)	- (2)	- (2)	
35745	Parts and attachments for adding, calculating, accounting machines, and cash registers	- (2)	- (2)	- (2)	- (2)	- (2)	- (2)	
35740	Calculating and accounting machines, N.E.C.	11.0	0	11.0	0	0	0	0
35760	Scales and Balances, Except Laboratory	182.1	0	0	172.0	0	10.1	5.9
3572	Typewriters(3)	1,046.[illegible]	(Over 2)	(Over 2)	0	912.7	(Over 2)	
3579	Office Machines, N.E.C.							
35792	Typewriters(3)	- (1)	(Under 2)	(Over 2)	0	- (1)	(Over 2)	
35793	Duplicating machines	83.6	0	0	0	79.0	4.6	
35794	Dictating, transcribing, and recording machines	254.7(4)	(Over 2)(4)	(Over 2)(4)	0	170.5(4)	(Over 2)(4)	
35795	Mailing, letter handling, and addressing machines	128.6	(Under 2)	0	0	122.6	(Over 2)	
35796	All other office machines, N.E.C.	- (4)	(4)	- (4)	- (4)	- (4)	- (4)	
35798	Parts and attachments for addressing, dictating, duplicating, and other office and store machines, N.E.C.	- (1)	(Under 2)	0	0	- (1)	(Over 2)	
35790	Office machines, N.E.C.	18.0	0	0	0	18.0	0	

*Source: 1972 Census of Manufactures, U.S. Department of Commerce.

(1) Withheld to avoid disclosing figures for individual companies.

(2) Data for 1972 product code 35741 00, adding and calculating machines, include data for product codes 35743 00, accounting machines and cash registers; and 35745 00, parts and attachments for adding, calculating, and accounting machines, and cash registers.

(3) These products were previously identifited as product class 35720.

(4) For 1972, data for product code 35794 00, dictating, transcribing, and recording machines, are included with product code 35796 00, all other office machines, N.E.C., to avoid disclosing data for individual companies.

N.E.C. Not Elsewhere Classified.

TABLE II-11

PERCENTAGE OF PRIMARY INDUSTRY SHIPMENTS SHIPPED BY OTHER INDUSTRIES

SIC	Industry	Percent
3551	Food Products Machinery	8.5
3552	Textile Machinery	3.3
3553	Woodworking Machinery	8.8
3554	Paper Industries Machinery	6.9
3555	Printing Trades Machinery	7.9
3559	Special Industries Machinery, N.E.C.	18.0[2]
3572 }[1]	Typewriters	4.3[2]
3579 }	Office Machines, N.E.C.	
3573	Electronic Computing Equipment	9.0
3574	Calculating and Accounting Machines	19.2
3576	Scales and Balances Except Laboratory	5.9

Source: 1972 Census of Manufactures, U.S. Dept. of Commerce.

[1] SIC's 3572 and 3579 are not segregated in Census data.

[2] Estimated from Census data.

SECTION III

MANUFACTURING PROCESS AND WASTE CHARACTERIZATIONS

INTRODUCTION

The character and quantity of the process wastes generated in the special machinery and office machines manufacturing industries as defined by SIC 355 and 357 are directly related to the process or processes used in any given manufacturing establishment. There is a great variety of raw materials used to manufacture the products of these industries, many of which are used in more than one process and eventually become, to some extent, waste constituents.

The purposes of this section are to describe the overall nature of the SIC 355 and 357 manufacturing operations, and to describe the potentially hazardous wastes generated. This will be done by, first, setting forth the criteria used by WAPORA to assess the hazards of special machinery manufacturing wastes. The various types of raw materials used by the industries are discussed in terms of their characteristics and normal applications. The rationale for considering each class of raw material as hazardous or nonhazardous is given. Next, descriptions of manufacturing processes are provided. Typical manufacturing establishments within SIC 355 and 357 are described, then each process (such as casting, forging, electroplating, assembly, etc.) is discussed. Within these discussions are estimations of the nature and amount of the process wastes generated and their classification as potentially hazardous or nonhazardous.

Waste generation rates for 1975 are developed for special machinery and office machines manufacturing plants in this section through extrapolation of waste quantity data obtained in the plant surveys. The number of production workers assigned to each process (based on survey data) is used along with 1967 Census data for developing estimates of national quantities. State totals are determined by production worker distribution by state as reported by the Census Bureau. EPA Regional waste totals are also provided.

Tabulations of waste quantities by waste stream are set forth by total waste, total potentially hazardous waste, and total potentially hazardous constituents.

Projections of 1977 and 1983 waste generation rates are also presented and are based on two factors: 1) percentage of industry growth; and 2) effect of the 1977 and 1983 effluent limitations and standards which will be imposed on the liquid wastes of these industries by the 1972 amendments to the Federal Water Pollution Control Act (PL 92-500). The applicability and probable effects of the various effluent restrictions are described. The quantities of the process wastes generated on a national basis, including total wastes, total potentially hazardous wastes, and certain hazardous constituents, are provided in various reporting formats on both a wet-weight and a dry-weight basis. More detailed breakdowns of waste generation are subsequently developed in an appendix.

CRITERIA FOR THE DETERMINATION OF A POTENTIALLY HAZARDOUS WASTE

There are many definitions of "hazardous materials" in use today. They are variously designed for application in implementing, such as the Clean Air Act, the Longshoremen's and Harbor Worker's Compensation Act, and Department of Transportation regulations. Others are built into legislation on solid waste disposal, and still others have been posed for purposes of earlier EPA hazardous waste studies relating to other industries. The two considerations, stated or implied, most common to all of them are the potential for acute or chronic adverse effects. This concept is also inherent in the hazardous criteria applied in this report.

One definition of "hazardous waste" in rather wide use is any waste or combination of wastes which pose a substantial present or potential hazard to human health or living organisms because such wastes are lethal, nondegradable, or persistent in nature; may be biologically magnified; or may otherwise cause or tend to cause detrimental cumulative effects [13]. In interpreting this definition in its Report to Congress, Disposal of Hazardous Wastes, [13], EPA established five categories of hazardous characteristics. They are: toxic chemical, flammable, biological, radioactive, and explosive. The wastes generated by SIC 355 and 357 plants fall within the first two of these categories. No wastes are produced which meet the definitions of radioactive, explosive, or biological categories set forth in the report.

Toxicity is defined in the Report to Congress as the ability of a waste to produce injury upon contact with or accumulation in a susceptible site in or on the body of a living organism. Toxicity, as it applies to the wastes of these industries, may be manifested in several ways. A corrosive waste may produce dermal irritation, an acute toxic effect. This type of waste may also be involved in long range situations because of interaction with metals or other wastes. Genetic change and bioconcentration are also long terms effects which are not immediately discernible. The remaining manifestations of toxicity, ranging from minor systematic or local injury to death, are grouped under the umbrella term of "toxicity" for the purposes of this report.

While these effects, in the usual use of the term, are frequently exhibited in acute form, the effects which may result from the wastes of these industries are most likely to be long term, chronic type effects. This is because wastes are produced which by almost any definition must be classified as potentially hazardous, but the quantities generated are unlikely to create acute situations in the ambient environment.

The degree of flammability of a waste is rather easily established as discussed below, but most toxic effects are not as readily measured.

Toxicity

Within the scope of this project, assessment of whether wastes may present a potential hazard due to toxic effects must be based on available information and evidence generated by experts in the toxicological field. The body of toxicological literature, however, suffers certain deficiencies for the purposes of this program. The most serious of these is that it is nearly all occupationally or laboratory oriented. Correlations between concentrations of substances and morbidity and mortality data are scarce, and frequently an episode — ranging from simple irritation to death — is described without reference to the amount of the compound which engendered it. In the few cases where this information is given, however, it usually documents toxic responses to higher concentrations than levels which could be expected to accrue from deposition of relatively small quantities of these substances in a land disposal operation. Few epidemiological facts are available and information developed on the basis of occupational or laboratory exposure must be substituted.

The literature is replete with descriptions and documentation of the toxicity of elemental substances, but reliable information on certain specific compounds used by manufacturing plants within SIC 355 and 357 is sparse or apparently nonexistent on some materials which have only recently come into use. In some cases where data are available, multiple references are in conflict with one another.

Because of these constraints on documenting the chronic long term toxicity of compounds at various concentrations, it was decided to accept the Quality Criteria for Water (Prepublication copy) issued by the U. S. Environmental Protection Agency [14] as a basic criterion for this hazardous property where possible — i.e., a process waste constituent which leaches in a concentration which exceeds the suggested water quality criteria renders the waste potentially hazardous.

An acute toxic criterion applicable to special machinery and office machines manufacturing wastes is somewhat easier to document since it is more closely akin to occupationally-oriented concentrations. This is the corrosivity/dermal irritation criterion which, for purposes of this study, has been set at a pH of less than 5.0 and greater than 9.0, which are widely accepted safety ranges [15].

The mere presence of a toxic substance in a process waste stream does not signify that the substance can be extracted from the waste into the environment. Therefore, one of the criteria established for a potentially hazardous waste was that the toxic substance must be water-leachable from the waste. Data were developed through laboratory leachate tests performed by WAPORA on process waste samples collected at surveyed plants to support this approach. The test procedures are documented in Appendix G. In the case of foundry wastes, these leaching tests were corroborated by a similar program underway at the University of Wisconsin under the sponsorship of the American Foundrymen's Association [64].

Bioconcentration may be defined as the selective concentration, or storing, of a specific chemical species by an organism. This phenomenon occurs in organisms ranging from water-borne microorganisms to humans. An organism's own chemistry will determine which substances it will accumulate and in what quantities.

While there is still a great deal to be learned about this process, there is ample evidence to show that several substances contained in the wastes from the manufacture of special machinery and office machines can be retained and stored by organisms up to harmful levels. These include cadmium, lead, mercury, and polychlorinated biphenyls (PCB's) [17-24]. Thus, the entry of any amount of these substances into the environment is undesirable from the standpoint of the potential long term hazards. However, cadmium, lead, and mercury are naturally present in at least trace amounts in many materials which become wastes, and PCB's have become widely disseminated in recent years. This being the case, the bioconcentration criterion for use in this report is that any measurable amount of these substances in a waste results in a hazardous designation.

Carcinogens, mutagens, or teratogens — materials which cause cancer or genetic change — are not widespread in SIC 355 and 357 wastes. However, a few suspected carcinogens may be present although trichloroethylene was the only suspected cancer-inducing agency which the surveys showed to be in common use. Current studies on this solvent may provide more evidence of the nature of its reaction on organisms. No use of other hydrocarbons in the suspect class has been reported by surveyed plants. Arsenic, a known carcinogen, is used in one surveyed plant which will be discussed in the section on treatment and disposal of wastes. This is a highly specialized application and does not indicate general usage of this chemical within the subject industries.

Nitrates are probably the only suspected mutagens — substances held responsible for changes within the genes — which may be present in the wastes of these industries. None were reported in the surveyed plants, but the literature indicates this potential. According to the National Academy of Sciences, teratogenic effects are usually seen only at doses well above likely exposure levels for environmental chemicals such as solvents and some compounds of mercury, lead, cadmium, and other metals [25]. In simple terminology, a teratogenic effect is the creation of abnormalities during gestation.

Introduction of carcinogens, mutagens, or teratogens into the environment in any quantity is undesirable. It was established that a process waste containing a constituent which is determined by EPA to have any of these characteristics constitutes a potentially hazardous waste when the constituent is present in detectable quantities.

Flammability

The second criterion applied to the process wastes of the subject industries in determining their hazardous nature is the measure of flammability. Any waste with a flash point of 38°C (100°F) or less as measured by the Closed Cup method is deemed a potential acute hazard. This is the limit which is used by the Department of Transportation to designate hazardous flammable solvents which require a red label warning.

The application of the measure of flammability to specific pure organic solvents is quite precise. This information is widely available in chemical and supplier literature. The flash point of mixed solvents as well as solvent-laden wastes is not as well established although a new test procedure has been developed and has been implemented to test the flash point of selected wastes [26]. Actual flash point determinations of certain sampled process waste streams from surveyed plants were made in WAPORA's laboratory to support this approach.

DEFINITION OF POTENTIALLY HAZARDOUS PROCESS WASTE

A process waste is defined as a residual material emanating directly from a manufacturing process such as casting operations, machining operations, paint shops, etc. Constituents of process wastes are generally oils, metals and metallic compounds, acids and alkalies, and organic solvents. These constituents, under certain conditions described earlier in this section may be toxic or flammable, rendering them hazardous to man and his environment. A process waste is defined as potentially hazardous by the contractor if its constituents cause the waste to have one or more of the following properties:

Hazard	Criteria for Waste Stream
Flammability	Flashpoint less than 28°C (100°F) (DOT)
Corrosivity/dermal irritation	pH less than 5.0 or greater than 9.0 [15].
Toxicity	Water leachate of a waste contains a chemical which exceeds Federal Quality Criteria for water [14]
Bioconcentration	Contains cadmium, lead, mercury, or PCB, in any detectable concentration
Genetic change	Contains any detectable concentrations of a known carcinogen, mutagen, or teratogen

Several discrete process wastes may be included in any particular waste stream from a manufacturing process area. Typically, segregation and recovery of discrete process wastes is not typically practiced (see Section VI - Treatment and Disposal Technology) so that both potentially hazardous and nonhazardous process wastes are handled and disposed of together. This generally renders the entire waste stream potentially hazardous.

When waste streams are mechanically handled and chemically treated on the manufacturing plant premises to the extent that they no longer meet any of the above criteria, they are not considered potentially hazardous waste streams for disposal.

RAW MATERIALS

A great variety of raw materials is used to manufacture special industrial machinery and office computing and accounting machines. This is true for several reasons. Many chemicals may be used interchangeably in the same application, although even slight variations in process may dictate different formulations. Some compounds are more effective on, or conversely, completely incompatible with certain metals. In addition, a wide range of metals is available for selected use.

In spite of the wide variety in specific raw materials, however, most of them fall within five major classifications:

1. Oils
2. Metals and metallic compounds
3. Acids and alkalies
4. Organic solvents
5. Miscellaneous materials

The general nature of these materials is discussed in this section and the physical/chemical properties of specific substances are tabulated in Appendix H. The materials listed in Appendix H are those found in use in surveyed plants with the exception of the acids and alkalies. Since the specific compound used in this class of materials was rarely identified, ones typically used were obtained from the literature. This section also describes the basic functions of these materials in SIC 355 and 357. The specific processes in which they are utilized are identified later in this section.

Oils

Oil is widely used in metal working operations. In addition to its function in many cutting, grinding, and stamping processes, it also serves as a lubricant in other miscellaneous uses. While a variety of fluid mixtures is used in individual applications, most of the oil itself is derived from refined petroleum. Smaller quantities of animal or vegetable oils from various sources — lard, for example — are employed in specialized uses, either alone or blended with mineral oil. There are insufficient data available to this study to support a breakdown by derivation, and since petroleum products are vastly predominant, the term "oil" as used in this report means a petroleum derivative unless otherwise specified.

Mixtures of hydrocarbons derived from crude petroleum used vary in chemical composition and viscosity [40]. They are composed of straight and branched chain aliphatic, naphthenic, aromatic, and polyaromatic hydrocarbons [41,42].

Most oils used in the manufacture of machinery can be generally classified by application as hydraulic, lubricating, cooling, or cutting oils. These basic groups of oil generally derive from the refined petroleum end product category called lube oil blending stocks which are produced from a lower, or heavier, fraction of the crude oil than gasoline and other fuels [41]. Thus, the properties of the mineral oil content of the fluids used in metal working are essentially the same originally, and some oils may be used in their virgin refined state.

In other cases, various substances which are usually termed additives — ranging from water to complex chemicals — are added to enhance an oil characteristic such as viscosity or freezing point for one purpose or another.

While various processes may dictate specialized formulations, the oils used generally as lubricants, hydraulic fluids, cutting oils, coolants, and quenchants are sufficiently similar that they can be characterized according to this grouping.

All of these oils are considered by the contractor to be hazardous materials. While oil itself is not highly toxic to humans, prevalent additives in oils which contain heavy metals or other toxic constituents are potentially harmful [16,21]. In addition, oils are toxic to aquatic life and shore wildlife at relative low concentrations [15,43].

Hydraulic Fluids

The use of hydraulic fluids in metal working is probably the least important use of oils in terms of wastes produced. Hydraulic oil is used as a fluid in the mechanics of metal working -- to supply drive or to transfer mechanical energy in closed systems, power presses, for example — and becomes waste only when a system is cleaned or when spills or leaks occur.

Hydraulic oils are one of a group of highly refined industrial lubrication oils obtained by extracting solvents from lube oil stocks and removing excess wax content [41]. They are likely to contain rust inhibitors such as imidazolines, alkenylsuccinic acids, and amine phosphates; oxidation inhibitors such as zinc dithiophosphate, sulfates, hindered phenels, and amines; corrosion inhibitors such as metal dithiophosphates; and foam inhibitors such as silicones [41]. Oxidation inhibitors are used to prevent acid and sludge formation and thickening. Rust inhibitors protect nonferrous components such as bearings from scoring by acid contaminants in the oil. Foam inhibitors reduce the stability of bubbles formed in an agitating system and thus prevent overflow [41]. Additional additives may include pour paint depressants to control the behavior of the wax remaining in the oil, and antiwear compounds which are similar to those used for oxidation and corrosion resistance [41]. Hydrualic oils are generally separated easily from water.

Lubricating Oils

Lubricating oils discussed here are those used to reduce friction in the operation of machinery, to lubricate molds and dies, and similar purposes as opposed to the lubricating functions of cutting oils described below. This type of oil is also subjected to wax and acid reduction as well as for color and asphalt removal [44]. The higher-grade lubricants also undergo solvent extraction with phenol, furfural, and sulfur dioxides to remove the aromatic portions [44].

The characteristics demanded of lubricating oils depend in large measure on whether they are used in a circulating lubrication system (such as a hydraulic system) or whether they are intended for "once-through" application. The composition of the former is very similar to that of hydraulic oils. The latter may require the addition of additives such as oleic acid to increase "oiliness" and enhance adherence in the presence of the water contained in cooling and cutting oils [41].

Barium sulfonate, a salt of an alkyl aryl sulfonic acid, is probably the most common detergent in current lubricating oils [21]. In 12 commercially available additives of this type, the barium content ranged from one to 15 percent. No figures were found on the percentages of this additive in the total product.

Tri-o-cresyl phosphate (TCP), which enhances the ability of oil to wet the metal surface, is another widely used additive in lubricating oils. A reference to a lubricating oil for turbojet engines indicated a three percent TCP content [16]. No information relating specifically to the oils used by SIC 355 and 357 was found.

Cutting Oils and Coolants

Cutting oils and coolants are the fluids used in the cutting and grinding of metal to cool both the workpiece and the tool and to lubricate the interface between the two [36,44]. Oils used in quenching are discussed separately.

An insoluble cutting oil, called "straight" oil, may be 100 percent mineral oil or a combination of mineral oil and a fatty oil such as lard or sperm oil [44]. Small quantities of bactericides and/or sulfur, chlorinated fats, sulfochlorinated fats [44], and other substances are sometimes added to provide more substantial lubrication. Industrial oil as refined contains almost no sulfur because it is removed in the refining process. Sulfur, as an additive, improves machinability.

More and more use is being made of water soluble cutting oils which usually range in ratio from 1:5 oil to water to 1:50. Stabilizers such as high molecular weight alcohols, esters, or amines are added to dissolve hydrocarbons and to create an affinity for water. They also may contain many of the additives discussed above including bactericides, corrosion and foaming inhibitors, and extreme pressure aids, as well as dyes and water conditioners such as sodium carbonate, polyphosphates, or borax [44,45]. Palm oils or other emulsions may be substituted for petroleum products [40].

Chlorinated oils have been used for many years in cutting oils because of their effectiveness under extreme pressure conditions

[45]. However, they are difficult to remove from metal parts and tend to engender rust on ferrous metals and stains on others. This effect has been reduced by the addition of emulsifiers, and, more recently, by ethoxylated fatty amines [45].

Cutting oil in normal use is recycled and is discarded only when it is too rancid or degraded by biological oxidation or contamination to be suitable for further use [42]. In larger plants, the coolant is recirculated to the machine tools from a central tank and pumping system, and in smaller plants each machine has its own recirculation system. Cast iron and some nonferrous materials do not require a lubricant or coolant, as noted above.

Quenching Oils

Conventional quenching oils are blends of crude oil fractions which contain no additives to alter cooling characteristics. Fast quenching oils are created through the use of additives, usually of a proprietary nature [36]. Water-oil emulsions are less effective for quenching than conventional oils whether the highest percentage of content is oil or water [36].

While oil itself is not highly toxic to humans, it is highly toxic within aquatic and marine food chains and to shore wildlife [15,43]. In addition, the oil used in the special machines manufacturing industries may contain one or more of a wide variety of additives and miscellaneous compounds in diverse concentrations. These materials may include barium sulfonate, zinc dithiophosphate, hindered phenols, chlorinated fats, sodium nitrate, and antimony trioxide, among many others. The Federal Water Quality Criteria document the toxicity of the alkyl-aryl sulfonate class of detergents on fish, to which barium sulfonate, belongs [15].

The existing Water Quality Criteria for oil are that oil should be virtually absent, or desirably, completely absent, from public water supplies. This is not based primarily on toxicity but rather on the taste and odor which oil may impart to humans. However, the fish and wildlife criteria provide that oil should not be added to receiving waters in such quantities that it will become an effective toxicant. In the revised criteria for aquatic life, presently undergoing final review, a numerical limit is applied to oil which is 0.01 of the lowest continuous flow 96-hour LC50 to several important freshwater and marine special [14]. For several oil types this would result in a limit on the order of 0.01 ppm. Since the runoff of oil from improperly discarded process wastes could exceed the Water Quality Criteria, it was established that a process waste containing more than 0.01 ppm of oil and grease is considered potentially hazardous.

Metals and Metal Compounds

The surveyed plants reported using gray and ductile iron, carbon steel, stainless steels, bronze, brass, aluminum, chromium, copper, nickel, zinc, cadmium, tin, and precious metals — including gold, silver, and rhodium. Some of these metals are employed in their solid, metallic state as structural machine components including iron, steel, aluminum, brass, and bronze. Others are used primarily in compounds such as soluble salts of the metals for plating and other surface finishing operations. Examples of the soluble salts found in surveyed plants are nickel sulfamate, cupric chloride, cupric oxide, cupric ammonium hydroxide, and chromate ions. However, compounds were not usually identified chemically and the metals used in plating were more frequently referred to generically. They include — in addition to nickel, copper and chrome — zinc, tin, cadmium, gold, silver, and rhodium. One arsenic and selenium alloy was encountered in a vacuum coating operation.

Since the identity of specific compounds was not often known, it was necessary to use the literature to identify the typical compounds employed in finishing processes. Table III-1 shows the composition of some common plating baths [46]. The cyanides are employed to hold metal ions in solution so that they may be deposited on a base metal [47]. In some heat treating operations, work pieces are immersed in a metal salt bath prior to their entry into the furnace. Molten cyanide salts, barium chloride, neutral chloride, or nitrate are frequently employed [34].

The metals used by SIC 355 and 357 in their metallic form for structural components of their products are not intrinsically hazardous, in terms of the criteria set forth in this report, when they are in sufficiently large dimension to resist solubilization. However, small particles are more subject to dissolution by other substances such as acids and alkalies. The potential for formulation of harmful metal compounds increases as particle size decreases. This is because dissolution occurs at the metal surface and the rate of dissolution is proportional to the surface area available and, for any given weight of a material, surface area increases as particle size decreases. Metals containing aluminum, copper, tin, zinc, and other amphoteric elements could be soluble at a pH that is acidic or basic. Most other metals (chromium, nickel, and iron which are the common ingredients of stainless steels) are more soluble at a pH that is acidic. Thus, the dusts and grindings of metals covered by the Water Quality Criteria render a process waste potentially hazardous when their leachate exceeds the numerical limitation.

Similarly, metal salts in solution which leach in amounts which exceed these limitations also cause a process waste to be potentially hazardous. The potential for runoff from improper land disposal

TABLE III-1

COMMON PLATING BATH FORMULAE

Metal	Constituent	Concentration	
		gm/l	oz/gal
Nickel	nickel sulfate	300	40
	nickel chloride	60	8
	boric acid	45	6
Chromium	chromic acid	397	53
	sulfuric acid	30	0.53
Copper (acid)	copper sulfate	202	27
	sulfuric acid	49	6.5
Copper (cyanide)	copper cyanide	22	3
	sodium cyanide	34	4.5
	sodium carbonate	15	2
Copper (pyrophosphate)	copper (as proprietary mix)	30	4
	sodium pyrophosphate	217	29
	0.4% ammonia (by volume)	--	--
Cadmium	cadmium oxide	26	3.5
	sodium cyanide	109	14.5
Zinc	zinc cyanide	60	8
	sodium cyanide	42	5.6
	sodium hydroxide	75	10
Brass	copper cyanide	30	4
	zinc cyanide	9	1.25
	sodium cyanide	56	7.5
	sodium carbonate	30	4
Tin (alkaline)	sodium stannate	120	16
	sodium hydroxide	715	1
	sodium acetate	15	2
Silver (cyanide)	silver cyanide	30	4
	sodium cyanide	30	4
	sodium carbonate	45	6

Source: Reference 46.

could result in violation of the above regulations and criteria.

There is sufficient documentation of the tendency of cadmium, lead, and mercury to bioconcentrate to dictate that these elements be considered hazardous when they are present in any measureable concentration. The levels permitted under the Water Quality Criteria are so low that virtually any runoff from improper disposal might exceed them. They are 0.01 mg/l for cadmium, 0.05 for lead, and 0.002 for mercury. The desirable criterion for public water supplies for cadmium and lead is complete absence.

Acids and Alkalies

Alkalies and strong acids are used in several processes attendant to metal working. These include stripping, cleaning, and etching.

Alkaline cleaners are used to remove oily substances (mineral, vegetable, and animal oils); semisolids (greases, waxes, etc.), and solid soils (grinding and polishing abrasives, graphite, metal oxides, etc.) from cast, forged, or heat treated parts before they are electroplated or otherwise finished or processed and are applied by soaking, spraying, and electrolysis [34]. Many formulations are used to meet the diverse cleaning requirements although two basic components — builders and wetting agents -- are common, along with water, to all of them. Builders, which account for the bulk of the preparation, supply the cleaning effectiveness and many other individual properties as desired [34]. Typical builders are sodium compounds, including carbonates, phosphates, silicates, and hydroxides [48]. Wetting constituents (surface-active agents) may be snythetic detergents or sodium resinate, a waste by-product of kraft pulping, or a combination of these materials [34]. Typical alkaline cleaner formulations designed for use on various metals are shown in Table III-2. Alkaline cleaning may also be practiced as a post treatment.

Acid cleaners used in metal working fall generally into five categories [34]:

1. Inorganic acid solutions
2. Organic acid solutions
3. Inorganic and organic mixtures
4. Acid-solvent mixtures
5. Solutions of acid salts

The organic acids include citric, tartaric, acetic, oxalic, and gluconic; inorganic acids include ammonium persulfate, sodium acid sulfate, and bifluoride salts. Typical acid cleaner formulations are shown in Table III-3. The pH ranges from 5.5 to much more acidic [34].

TABLE III-2

TYPICAL ALKALINE CLEANER FORMULATIONS FOR VARIOUS METALS

Metal for which cleaner is designed:	Aluminum		Copper			Cu Plate	Iron and Steel			Magnesium		Zinc		
Type of application:	Soak	Spray	Soak	Spray	Electro-lytic	Electro-lytic	Soak	Spray	Electro-lytic	Soak	Spray	Soak	Spray	Electro-lytic
Composition of Cleaner, % by Weight														
Builders:														
Sodium hydroxide, ground	..	..	20	15	15	55	20	20	55	20	20	..	15	15
Sodium carbonate, dense	..	..	18	..	..	8	18	29	8.5	18	29	..	..	..
Sodium bicarbonate	21	24	..	34	34	..	..	..	..	..	..	..	35	34
Sodium tripolyphosphate	30	30	..	..	10	..	20	20	10	20	20	90	10	10
Tetrasodium pyrophosphate	..	..	20	10	..	10	..	..	..	..	..	..	..	..
Sodium metasilicate, anhydrous	45	45	30	40	40	25	30	30	25	30	30	..	40	40
Surface-active (wetting) agents:														
Sodium resinate	..	..	5	..	..	..	5	..	..	5	..	5	..	..
Alkyl aryl sodium sulfonate	3	..	5	..	..	..	5	..	1	5	..	5	..	..
Alkyl aryl polyether alcohol	..	..	2	..	..	1	2	..	..	2	..	..	..	..
Nonionics high in ethylene oxide	1	1	..	1	1	1	..	1	0.5	..	1	..	..	1
Concentration of Cleaner														
gm/liter:	30	7.5	60	7.5	60	60	60	7.5	60	60	7.5	30	7.5	45
(oz/gal.):	(4)	(1)	(8)	(1)	(8)	(8)	(8)	(1)	(8)	(8)	(1)	(4)	(1)	(6)

Source: Reference 34.

TABLE III-3

TYPICAL ACID CLEANER FORMULATIONS FOR FERROUS METALS

Type of Application:	Immersion		Spray		Barrel	Wipe	Electrolytic
Composition, % by Weight	Type #1	Type #2	Type #1	Type #2			
Phosphoric acid	70	..	70	..	..	15 to 20	..
Sodium acid pyrophosphate	..	16.5	..	16.5	16.5	..	..
Sodium bisulfate	..	80	..	80	80	..	..
Sulfuric acid	..	..	..	..	..	..	55 to 70
Nonionic wetting agent	5	..	5	..	..	7 to 20	..
Anionic wetting agent	..	3	..	3	3	..	..
Other additives*	..	..	..	..	..	..	..
Water	25	..	25	..	..	Remainder	Remainder
Concentration of Cleaner in Water							
gm/liter:	120	60 to 160	60	15 to 30	15 to 60	..	..
(oz/gal.):	(16)	(8 to 16)	(8)	(2 to 4)	(2 to 8)	..	..

---

* These may include inhibitors, antifoaming agents, sodium nitrate, and nickel nitrate.

Source: Reference 34.

Acidic pickling is a more severe treatment than acid cleaning to remove oxides and scale. However, some cleaning acids may be nearly as strong as pickling solutions. Sulfuric, hydrochloric, nitric, and hydrofluoric acids are most commonly used in pickling [34,49]. Minimum sulfuric acid concentrations in pickling solutions for various metals range from 5 to 25 percent by weight [34].

The materials used in stripping, the removal of coatings from metal which has been improperly coated, vary from metal to metal, both in terms of the basis metal and the coating itself. Some of the standard substances used for stripping are: sodium hydroxide, sodium carbonate, hydrochloric acid, hydrofluoric acid, sodium cyanide, and nitric acid. Very small quantities of other chemicals such as antimony trioxide and sodium nitrate may be added to protect the surface of the basis metals or for other purposes. Examples of quantities used are as follows:

Plating & Coating	Basis Metal	Stripping Solution
Chromium	Steel	45 gm (6 oz) sodium hydroxide/liter (gal.) of water
Chromium	Nickel plated steel	Equal parts by volume, hydrochloric acid and water
Chromium	Magnesium and alloys	45 gm (6.5 oz) anhydrous sodium carbonate/liter (gal.) water
Gold, silver copper, nickel	Magnesium alloys	Proprietary alkaline chemical stripper with cyanide plus 15 gm (2 oz) sodium hydroxide/liter (gal.) of prepared solution
Cadmium	Steel, cast iron	105-135 gm (14-18 oz) ammonium nitrate/liter (gal.) water
Cadmium	Steel, cast iron	135-90 gm (18-12 oz) sodium cyanide 15-30 gm (2-4 oz) sodium hydroxide/liter (gal.) water

These compositions are all excerpted from Volume 2 of the Metals Handbook. All of these plating metals were reported in use by one or more surveyed plants, although no data are available to suggest whether these specific stripping solutions or similar ones are employed.

Strong acids are more prevalent in etching and nitric acid alone or in combination with other acids is frequently used [31]. However, alkaline solutions may be required for the surface of aluminum, its alloys, and other metals. Hot solutions of sodium or potassium hydroxide, trisodium phosphate, or sodium carbonate are commonly used [34]. The use of etching is not likely to be practiced extensively in the subject industries.

Many other metal processes such as electropolishing and anodizing also utilize concentrated acid or alkaline solutions. Substances used include sulfuric, phosphoric, chromic, and fluoboric acids, sodium carbonate, sodium bisulfate, and trivalent metals.

Most acid and alkaline cleaning solutions are hazardous. These materials present an acute hazard in handling and a potential for long term harm if appropriate disposal techniques are not employed. They are corrosive, both to humans handling them and to metals. Using the Water Quality Criteria for primary contact recreation, the safe range is accepted at 5.0-9.0. If acids and alkalies cause a process waste to fall outside this pH range, the waste is considered potentially hazardous.

Waste acids and alkalies may also carry toxic metal salts as well as bioconcentrative materials such as cadmium, lead, and mercury which, if present in detectable concentrations, render a process waste potentially hazardous.

Organic Solvents

The use of organic solvents in metal working operations is nearly as universal as that of oil. These materials are used in solvent-thinned painting operations, solvent cleaning of metals, molds, and dies, vapor degreasing, and emulsion cleaning, among others.

The solvents commonly used in metal cleaning are aliphatic hydrocarbons (kerosene, mineral spirits, Stoddard solvent, VM&P naphtha, etc.); chlorinated hydrocarbons (methylene chloride, trichloroethylene, etc.); alcohol (ethanol, isopropanol, and methanol); and others such as acetone and toluene. Stoddard solvent and mineral spirits probably see more use than the others because they are less expensive and have a relatively high flash point [34]. The amount used can be illustrated by the number of pieces cleaned per liter (gallon) of pure solvent consumed [34]:

High-Flash Naphtha

	Light Soil (Dip Cleaning)	Heavy Soil (Soak Cleaning)	
Small Pieces (1x1x1" max.)	15,840 (60,000)	3,960 (15,000) 1,003 (3,800)	(pre-clean) (high degree of cleaning)
Medium Pieces (12x12x12" max.)	528 (2,000)	1,584 (6,000)	(pre-clean)
Large Pieces (12x12x12" min.)	53 (200)	26 (100)	(pre-clean)

Chlorinated solvents such as methylene chloride and trichloroethylene are used in vapor degreasing, while emulsion cleaning commonly involves kerosene and mineral oil. The emulsions may also contain soaps, low- and high-molecular weight petroleum sulfonates, glycols and glycol ethers, and aromatic solvents [34]. Degreasing may also be accomplished by the use of a combination of vapor and liquid.

Many of the solvents used meet the foregoing criteria for flammability and are, thus, considered hazardous. Some of them are also toxic and some are suspected by at least part of the toxicological community of having carcinogenic properties. Such solvents include trichloroethylene and perchloroethylene. The organic chemicals for which maximum contaminant levels are set in the Water Quality Criteria do not include any solvents found in use in surveyed plants. They are, however, in the chlorinated hydrocarbon class and others in this category are used by SIC 355 and 357 plants, and are considered hazardous. If the presence of solvents causes a process waste to have a flash point less than 38°C (100°F), the waste is potentially hazardous. If a process waste contains a solvent considered as a possible carcinogen or mutagen, in any concentration, the waste is potentially hazardous.

Miscellaneous Materials

In addition to the raw materials of the castings themselves, foundries employ a number of materials to make the casting molds. A sand mixture containing up to 98 percent silica sand plus clay, a carbonaceous material such as ground bituminous coal, cellulose or various proprietary compounds, and water is perhaps in most widespread use. Plaster molds require some mixture of gypsum and talc with various additives such as lime and Portland cement. Silica, zircon, and similar refractory materials are used in investment and ceramic molds [27,28]. Three of the foundries in surveyed plants use sand molds and one employs ceramic molds produced by the Shaw process. None of these substances meet the foregoing criteria for hazardous materials.

A number of thermoplastic and thermosetting plastics are molded in plants having the capability to mold these parts on the premises. Phenolic resins and styrene were found in use in surveyed plants. These polymers are considered nonhazardous by the contractors as are adhesives used in assembly operations. They are similarly thermoplastic and thermosetting meterials or mixtures of both types of polymers [51].

A variety of compounds is utilized as fluxes in casting, galvanizing, and other heat/chemical processes. The purpose of these materials, which do not remain in the final product, is to enhance removal of impurities such as gases and oxides [50]. They include limestone, lime, fluorspar, chlorine, and a host of other materials. Some of these materials are nonhazardous and others must be considered hazardous — sometimes because of secondary products formed when they combine with metal impurities. An example of this occurrence is the formation of fluorine when fluorspar is used. Due to the limited number of plants surveyed with foundry operations, no first-hand data are available upon which to base specific hazardous/nonhazardous characterizations of these substances.

A wide range of paint and specialty coating products are used, including both solvent- and water-thinned materials. Paint-related wastes are hazardous because of the large variety of raw materials they may contain which could exceed the Water Quality Criteria. These include compounds of some of the metals listed above as well as organic solvents in some cases.

Spills, leaks, and equipment wash-ups have not been allocated to specific processes since no qualitative or quantitative data are available to support a description of typical wastes generated through these routes. Surveyed plants were generally quite conscious of the economic benefits to be derived through minimizing spills and leakage, and, in view of raw material costs, it can be reasonably concluded that this attitude is prevalent industrywide. The most significant spills from a standpoint of potentially hazardous wastes are those which may occur in electroplating. This subject is addressed in "Treatment of Potentially Hazardous Wastes," later in this report.

MANUFACTURING PROCESSES

Manufacturing processes form the integral parts of special machinery manufacturing operations. These processes are casting, forging, electroplating and etching, hot dip galvanizing, heat treating, machining, plate or structural fabrication, stamping, blanking and forming, coating, plastics molding, and assembly. In the context of this report, a process is the basic source of manufacturing waste and is used as the common unit for quantifying wastes. For example, a machining operation will generate 0.96 kkg/yr-dept. employee. Thus, the total process waste from a given plant's machining operation can be estimated by multiplying this factor by the number of employees working in the machining department.

Typical Manufacturing Plants

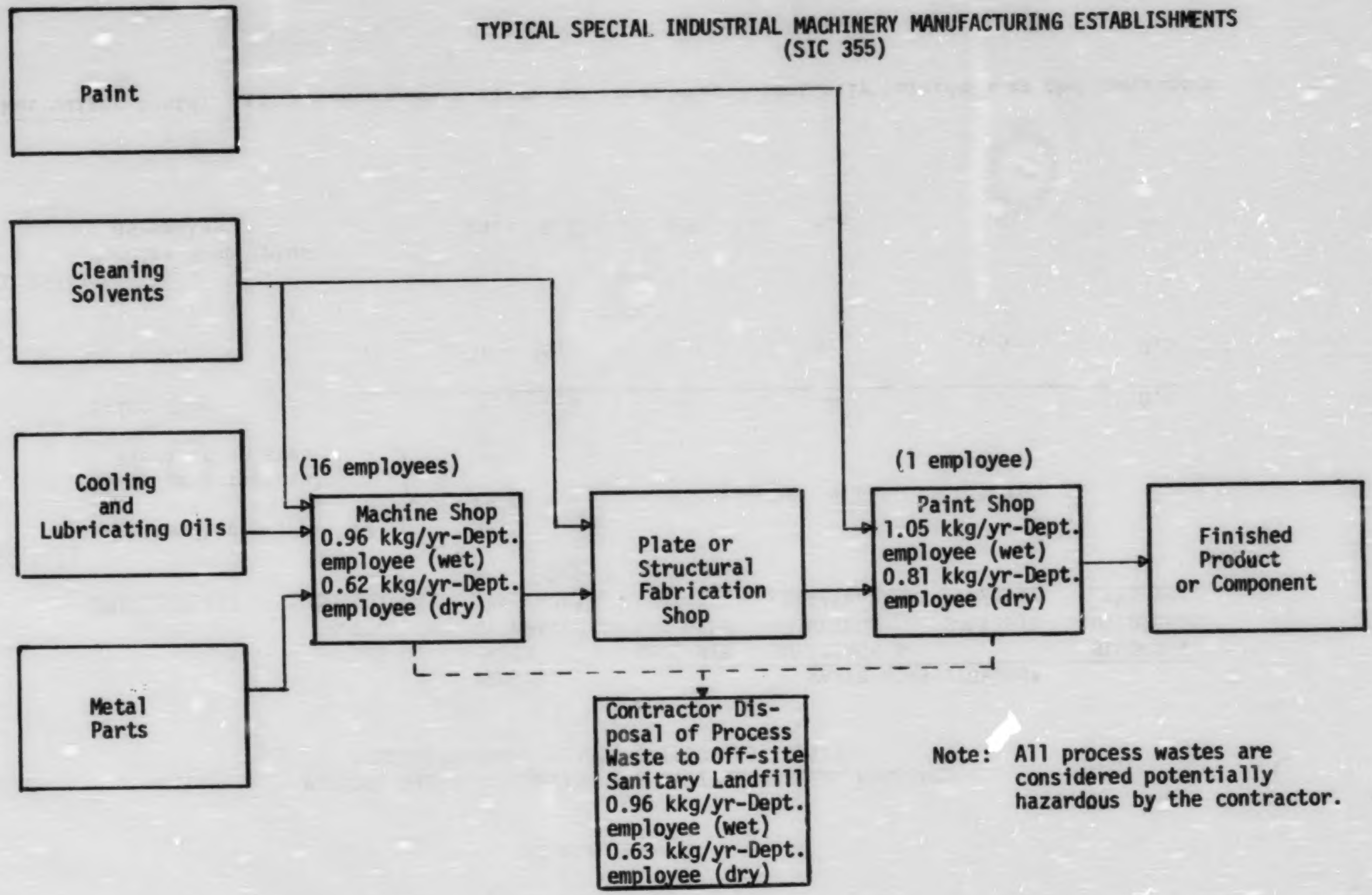
Virtually all of the common metal fabrication processes are utilized at some stage in the manufacture of special industrial machinery and office, computing, and accounting machines. However, all of these processes are not widely employed in the plants falling within SIC 355 or 357. A substantial portion of the metal parts used by these industreis, such as castings and forgings, are produced and finished elsewhere — in plants classified in other SIC categories — and are purchased as raw materials by many of the SIC 355 and 357 plants. In addition, many plants in these categories have their heat treating, electroplating, and galvanizing done by other firms when it is needed. Thus, the typical plant for roughly 90 percent of SIC 355 plants consists of a machine shop, sometimes with accompanying plate or structural fabrication and/or painting. Such a plant is illustrated in Figure III-1. Based on information collected during the surveys, no equipment for air pollution control or water pollution abatement is normally used. This is because (a) no process waste water streams are normally generated and (b) no stacks or air blower systems are used in typical installations.

The typical plant in SIC 355 has 17 employees, is located in an urban area within industrialized states such as California, New York, or Illinois, and is less than 10 years old. As shown in Table III-4, approximately 16.4 kkg/yr (18.0 tons/yr) of total process wastes on a wet weight basis are generated by the plant. On a dry weight basis, 10.7 kkg/yr (11.8 tons/yr) of process wastes are generated. Based on the definition developed earlier in this section, these wastes are considered potentially hazardous. They consist of spent coolants, sweepings, grindings, and solvents from the machining operation, and sludge, overspray, and solvent from the paint shop.

The solid process wastes are accumulated in a single trash container along with waste paper, cartons and garbage. The container is emptied and the drums collected from once per week to once per month by a private contractor. They are hauled to a sanitary landfill for disposal. The cost for this service is $300/year,

FIGURE III-1

TYPICAL SPECIAL INDUSTRIAL MACHINERY MANUFACTURING ESTABLISHMENTS
(SIC 355)


Paint
Cleaning Solvents
Cooling and Lubricating Oils
Metal Parts
(16 employees)
Machine Shop 0.96 kkg/yr-Dept. employee (wet) 0.62 kkg/yr-Dept. employee (dry)
Plate or Structural Fabrication Shop
(1 employee)
Paint Shop 1.05 kkg/yr-Dept. employee (wet) 0.81 kkg/yr-Dept. employee (dry)
Finished Product or Component
Contractor Disposal of Process Waste to Off-site Sanitary Landfill 0.96 kkg/yr-Dept. employee (wet) 0.63 kkg/yr-Dept. employee (dry)

Note: All process wastes are considered potentially hazardous by the contractor.

TABLE III-4

PROCESS WASTE GENERATION FOR TYPICAL SPECIAL MACHINES MANUFACTURING OPERATIONS (SIC 355 & 357)

UNIT PROCESS	NUMBER OF PRODUCTION EMPLOYEES	PROCESS WASTE GENERATED kkg/year*		WASTE CONSTITUENTS*			
		Wet	Dry	COOLANTS AND OILS kkg/year	SWEEPINGS & GRINDINGS kkg/year	SOLVENTS kkg/year	SLUDGE & OVERSPRAY kkg/year
SIC 355:							
Machine Shop	12	15.4	9.9	6.2	6.2	3.0	--
Plate or Structural Fabrication Area	4						
Paint Shop	1	1.0	0.8	--	--	0.5	0.5
TOTAL	17	16.4	10.7	6.2	6.2	3.5	0.5
SIC 357:							
Machine Shop (plus assembly)	15	14.4	9.3	5.8	5.8	2.8	--

---

* Wet weight basis. All process wastes shown are considered potentially hazardous by the contractor

including hauling and disposal, and translates to $18/kkg ($17/ton) on a wet basis and $28/kkg ($25/ton) on a dry basis.

The typical plant in SIC 357 is a machine shop followed by an assembly operation, as shown in Figure III-2. The plant is probably located in an urban area in an industrialized state such as New York or California and has slightly less than 20 employees. The plant age is less than ten years.

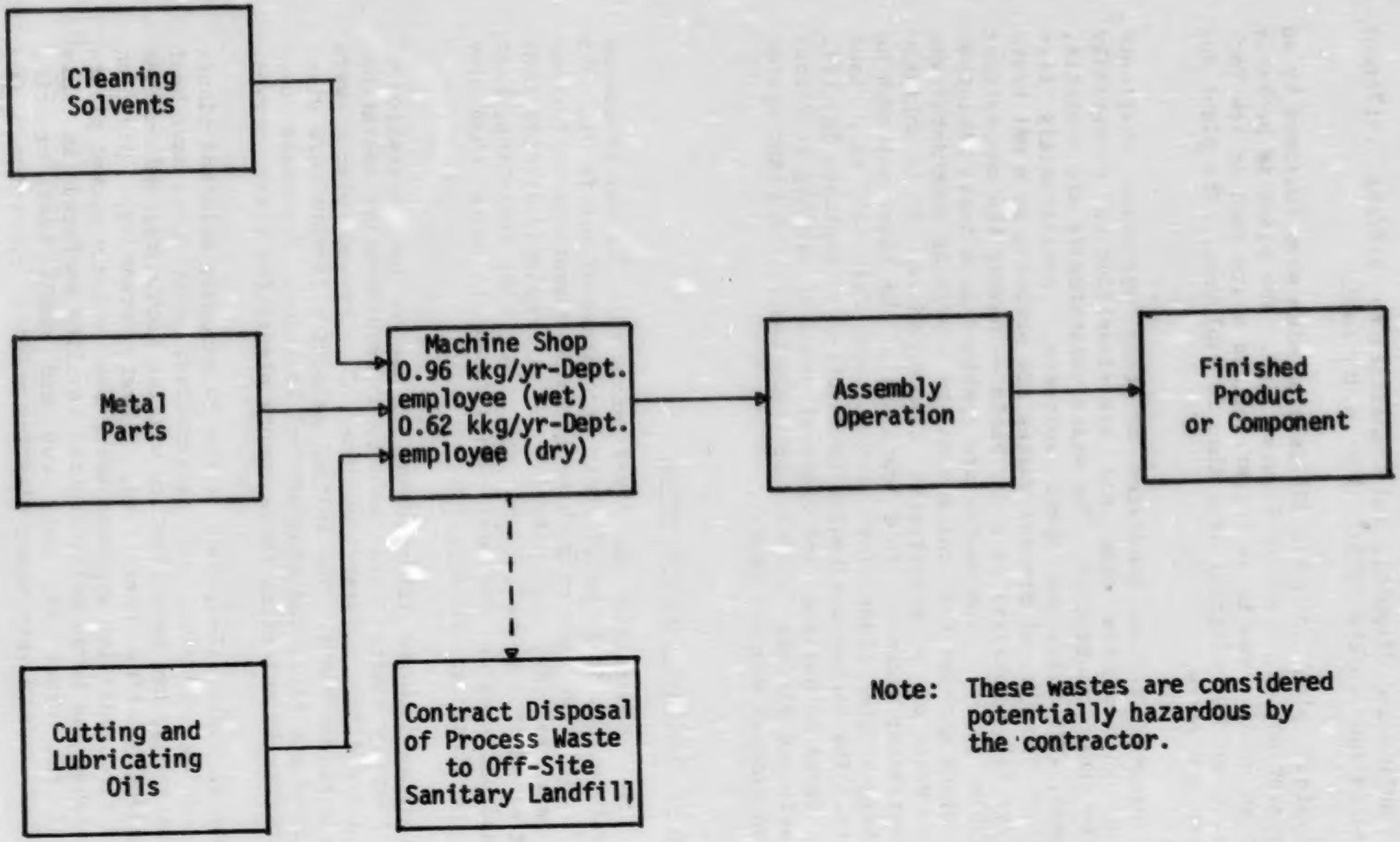
The process wastes generated by this operation originate entirely in the machine shop and are classified as potentially hazardous by this contractor. The waste constituents are coolants, oils, sweeps, grindings, and spent solvents. Approximately 14.4 kkg/yr (15.9 tons/yr) of process wastes are produced on a wet basis — 9.3 kkg/yr (10.3 tons/yr) on a dry basis — having the composition shown in Table III-4. The wastes are combined in a trash container along with other garbage for collection by a private contractor who picks up the waste on a prearranged time schedule. It is unlikely that the contractor picks up full loads all of the time, although he probably charges the plant for pick-up and disposal at a fixed monthly rate. The wastes are hauled to an off-site sanitary landfill operation. Based on hauling and disposal costs of $18/kkg ($17/ton) on a wet basis and $28/kkg ($25/ton) on a dry basis, the plant spends $260/year on process waste disposal.

Description of Manufacturing Processes

Table III-5 summarizes the 1967 Census data for the processes which generate wastes in terms of their percentage of use in SIC 355 and SIC 357. It shows that only three of these operations — ferrous foundries, heat treating, and painting — are employed at more than one percent of SIC 355 installations and that electroplating, heat treating, and painting are the only ones used in more than one percent of the plants in SIC 357.

In gathering data and information for use in the preparation of this report, survey visits were made to 33 manufacturing operations within SIC 355 and 357. Twenty of the 33 surveyed plants were selected on a random basis. The initial selection factors were size, product (four-digit SIC), and geographical location. Processes used were not a factor in selecting these twenty plants for plant survyes.

As shown in Table III-6, none of the 20 randomly selected plants engage in casting, forging, or galvanizing; only three have heat treating operations; two have plastics molding machinery; and one has extensive electroplating operations. Heat treating, plastics molding, and electroplating appeared among the randomly picked plants primarily because one large multi-faceted facility surfaced in this process. Of the other 19, only two had small heat treating operations and one a very minor plastics molding operation. One


Cleaning Solvents
Metal Parts
Cutting and Lubricating Oils
Machine Shop 0.96 kkg/yr-Dept. employee (wet) 0.62 kkg/yr-Dept. employee (dry)
Contract Disposal of Process Waste to Off-Site Sanitary Landfill
Assembly Operation
Finished Product or Component

Note: These wastes are considered potentially hazardous by the contractor.

FIGURE III-2

TYPICAL OFFICE, COMPUTING, AND ACCOUNTING MACHINES MANUFACTURING ESTABLISHMENTS
(SIC 357)
(15 employees)

TABLE III-5

ESTABLISHMENTS UTILIZING WASTE - PRODUCING PROCESSES

	SIC 355		SIC 357	
	Number of Establishments	Percent of Total Establishments	Number of Establishments	Percent of Total Establishments
Total Establishments	3590		1140	
Process				
Ferrous Foundry	70	2.0	3	0.3
Forging	9	0.3	3	0.3
Electroplating	33	0.9	53	4.6
Galvanizing	8	0.2	2	0.2
Heat Treating	159	4.3	42	3.7
Painting	685	19.1	31	2.6

TABLE III-6

DISTRIBUTION OF PROCESSES AMONG SURVEYED PLANTS

Process	20 Random Plants	13 Selected Plants	All Surveyed Plants
Ferrous Foundry	0	3	3
Nonferrous Foundry	0	1	1
Nonferrous Die Casting	0	3	3
Electroplating	1	8	9
Galvanizing	0	0	0
Heat Treating	3	8	11
Machine Shop	20	8	28
Tool & Die Shop	4	5	9
Plate or Structural Fabrication	10	2	12
Stamping, Blanking, Forming	6	5	11
Painting & Other Coating	15	11	26
Plastics Molding	2	4	6

randomly selected plant engaged in heat treating and electroplating but was not visited because of conflicting schedules in the plant. However, it can be used statistically to show that of 21 plants selected at random, less than 20 percent engage in heat treating and less than 10 percent mold plastics or electroplate.

The fact that these percentages are higher than the 1967 Census data on these processes is explained by the facts that even the randomly selected plants included more of the larger plants than would be expected from a statistically random sample, and the smallest plants, which were not proportionately represented in our sample, do not ordinarily employ the more complex processes. This bias in regard to size was not intended, and plants with less than 20 employees were included in the initial random selection lists. However, this bias was the natural result of the breakdown in the random process engendered by difficulties encountered in gaining entry to many SIC 355 and 357 plants, a problem which is described in Appendix G. Some of the establishments with a relatively small number of employees (perhaps 70 or less) were not as willing to contribute personnel time to the survey. On the other hand, some of the larger plants — especially those with data already assembled — found the survey less time consuming, and, thus, were more receptive.

Even with this bias in regard to size, the Census characterization of the majority of SIC 355 and 357 establishments was sufficiently confirmed by the first 19 plants visited. As Table III-6 shows, the randomly selected plants were almost exclusively machine shops. Three have tool and die shops and five engage in stamping, blanking, and forming. These were not major functions in any of the plants and were generally carried out in the machine shop. The forming process is limited to those making parts only. Fourteen of these 19 plants engage in painting to some degree, and 10 have plate or structural fabrication operations as noted above; only two practice heat treating and one, plastics molding.

After the first 20 plants, the random selection process was abandoned and new criteria for selection were established — i.e., that plants engage in one or more of the processes with the largest potential for waste generation as shown in Table III-1. A concentrated effort was made to find SIC 355 and 357 plants meeting this criterion. Subsequently, plants were selected for survey on the basis of contractor knowledge that they do operate foundries or engage in plating, heat treating, and/or extensive painting. These nonrandomly selected plants thus provided data on more complete metal working operations.

The following description of the metal working unit processes are based in part on the literature, particularly the multi-volume Metals Handbook published by the American Society for Metals the Volumes of which are referenced separately, and earlier related EPA reports which are also referenced. The processes described include metal casting (ferrous and nonferrous), metal forging, electroplating, glavanizing, heat treating, machining, tool and die operations, plant or structural fabrication, stamping, blanking, and forming, painting, plastics molding, and assembly.

The descriptions for each unit process include description and evaluation of the process wastes generated. The data and information required for these evaluations were compiled from the plant surveys.

In order to develop new information on the waste streams of these industries for the purpose of setting hazardous/nonhazardous classifications, 23 grab samples of liquid and solid materials were collected at 14 of the surveyed plants. The general guidelines for the collection of samples were that (1) the wastes should be destined for land disposal or incineration, (2) they should be generated in relatively significant quantities which was usually defined by the contractor as more than 190 liters (50 gallons) per year and (3) the waste should be available for sampling by the survey team. The waste streams sampled varied from one facility to another.

The analytical methods employed are described in detail in Appendix G. Briefly, the methodology was as follows:

Metals - atomic absorption spectroscopy
Oil and Grease - hexane extraction
Cyanide - distillation and colorimetric determination
H20 - Karl Fischer titration

The pH and heavy metals concentrations of the samples were analyzed in two ways. First, they were analyzed as they were received to determine the concentrations of the various constituents that were present. Second, the samples were leached with distilled water, and the leachate was analyzed for selected heavy metals to crudely ascertain the possibility that some of the metals could escape into the environment from the waste after land disposal. The heavy metals analyzed include cadmium, copper, chromium, iron, zinc, nickel, and manganese. They were chosen for analysis based on (1) their hazardous nature, and (2) the probability, in the contractor's opinion, of finding them in the waste streams in detectable concentrations.

Metal Casting

Metal casting is a process by which metal parts of varying shapes and complexities can be produced by pouring molten metal into the cavity of a mold, resulting in a solid metal part with the configuration of the mold cavity. Metal castings can be produced from any metal or combination of metals, but the vast majority of castings produced in this country are made of iron, steel, and alloys of aluminum, copper, magnesium, and zinc. The foundries seen in the surveyed plants produce mostly iron and steel castings, although some production of aluminum, brass, nickel, and zinc castings was also observed. Since the technologies for ferrous and nonferrous casting operations are similar, especially in terms of the types of wastes generated, they will be discussed together.

Almost every type of furnace is employed for melting of metals in foundries. Iron is melted in cupolas, electric arc furnaces , electric induction furnaces, and fuel-fired reverberatory furnaces. Steel is melted in electric arc furnaces, electric induction furnaces, and acid open-hearth furnaces. Nonferrous metals are melted in fuel-fired pot furnaces. [27]. Based on the relatively small number of foundries in the subject industries, along with the fact that only two foundry operations were visited during the plant surveys, the contractor cannot speculate whether any of these types of furnaces are dominant in SIC 355 or 357.

Furnace charge make-up varies with the type of metal being melted, and the method of melting employed. The cupola requires the greatest number of charge constituents. This is true because the fuel used, coke, is part of the furnace charge. This means that relatively large quantities of fluxing material — frequently limestone — are required to liquefy and remove impurities from the burning coke as well as from the scrap metal charge [27]. The electric induction furnace requires the least number of charge constituents. Since only minor chemical changes occur during melting in this process, the necessity for fluxing or refining is minimized. Generally, all alloying elements are added during the melting cycle, while inoculants are added to the molten metal in the ladle before pouring into molds [27].

Molds can be prepared from green (unbaked) sand, baked or dried sand, chemically bonded sand, ceramic material, plaster, and other refractory materials. These types of molds must be prepared for each casting and are broken apart when the casting is finished; reclaiming facilities provide for reuse of sand mold materials. Ceramic and plaster molds cannot be reclaimed and are discarded after one use. Permanent molds and dies can also be used for most metals where large quantities of relatively small castings are to be produced and where precision and good-as-cast finish is required. Mold materials for these purposes are iron, steel, copper, and graphite [27,28].

Cores are used in molds where cavities or hollow areas are required in the castings. Cores are generally made from sand which has been mixed with oil or chemical binders and cured to produce a shape of sufficient strength and permeability to withstand the temperature, thermal stresses, and gas evolution which occur during casting.

After castings have been removed from the molds, the excess sprues, gates, and risers is removed by shearing, cutting, or grinding. Castings are then cleaned of surface sand by oxidation and abrasive or metallic blasting, or by hydraulic blasting or tumbling [27].

Other operations which may be performed in foundries include heat treating, machining, pickling, and painting. Auxiliary departments found in foundries include patternmaking, mold rebuilding or repair, tool room, and plant maintenance.

A typical foundry operation is shown in Figure III-3. Metal castings used in special machinery and office machines manufacturing plants come from in-house foundries or captive foundries in other locations, or are purchased from outside sources.

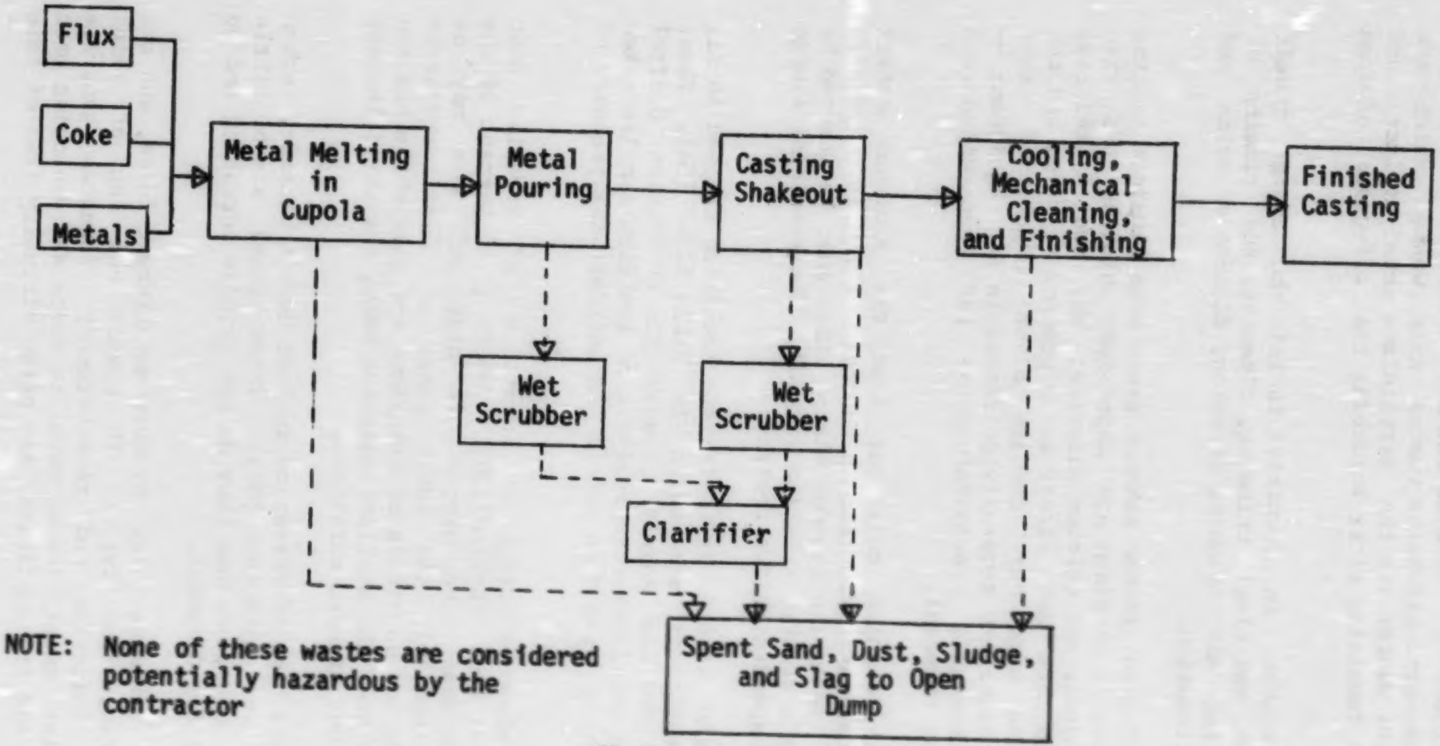
Only four of the surveyed plants operate a ferrous foundry on the premises, one of which also produced nonferrous castings. One other establishment operates its own foundry but it was not located on the same site as the manufacturing facility. This foundry was not considered in the study since its wastes did not comprise a part of the machinery manufacturing plant waste stream. Several other surveyed plants operate foundries which sell all or part of their castings to other firms and do not consume them in-house.

In some instances, the surveyed plants confirmed that a multi-plant company manufactures castings at one captive plant and distributes them from this facility to the rest of its plants over the country. This is exemplified by a large manufacturer of scales which maintains one foundry at a New England plant to provide castings to assembly-type operations in other areas.

Data are not available to identify the quantities of castings used in each category of manufacturing, or the sources of these castings. However, no foundries were operated on-site at any of the randomly selected plants. This fact and the relatively few foundries reported in these industries by the Census Bureau make it evident that the majority of the castings which are used are purchased from outside sources.

Several types of waste are generated by casting operations — both ferrous and nonferrous. These include (1) metals as particulates captured by air pollution equipment; (2) water contaminated by rinsing of casts, sand reclamation, and scrubbing of gaseous constituents; and (3) waste materials such as slag, dross, metal trimmed from the casting, spent sand, particulates from abrasive cleaning, oils, and solvents.

The furnaces used for melting metals are the sources of air-borne gases, dusts, fumes, smoke, and oil vapor. The cupola furnace, most widely used for iron, is the largest generator of


Flux
Coke
Metals
Metal Melting in Cupola
Metal Pouring
Casting Shakeout
Cooling, Mechanical Cleaning, and Finishing
Finished Casting
Wet Scrubber
Wet Scrubber
Clarifier
Spent Sand, Dust, Sludge, and Slag to Open Dump

NOTE: None of these wastes are considered potentially hazardous by the contractor

62 kkg dry waste*/yr-dept. employee

* Wet Weight = Dry Weight

FIGURE III-3

SIMPLIFIED TYPICAL FOUNDRY OPERATION
(24 employees)

airborne wastes followed by the electric-arc furnace. Air pollution control equipment converts air-borne wastes into wastes which are land disposed. These wastes are the particulate metal collected and the alkaline sludge remaining after scrubbing the off-gases of some metals.

Other waste sources in foundries include the charge itself (waste fluxes, dross, and slag); trimming, cleaning, and rinsing of castings; lubricating and cleaning of molds; discard of molds and cores; and sand reclamation.

The solids contained in the exhaust gases from aluminum casting operations may include aluminum and magnesium chloride and zinc oxide; calcium fluoride and calcium chloride; and sodium chloride [50]. All of them are not likely to be present at once, and the mixture at any one time may contain minor amounts of other substances. These dusts are generally collected in dry equipment — baghouses or electrostatic precipitators — and then dumped to a refuse container for disposal.

In addition to the solid emissions from the aluminum casting operation, exhausts may also contain hydrogen fluoride, hydrogen chloride, and chlorine in the gaseous state which must be removed by scrubbers utilizing a caustic solution [29,50]. The resulting sludge is quite high in suspended solids content.

Examples of the wastes from ferrous foundries trapped in air pollution control equipment are shown in Table III-7 [50]. These data, assembled by the Los Angeles County Air Pollution Control District, represent the laboratory analysis of two dust samples taken from a baghouse on a gray iron cupola and indicate the presence of over 20 metals.

Table III-8 shows a range of quantities of metallic dust emissions from gray iron cupolas [50]. Twenty to 30 percent of the particles are less than five microns in size and some may be submicron in diameter [50]. The table shows no clear correlation between cupola size and magnitude of emissions and that while the two largest operations have the smallest emission rate, the third largest cupola has the second highest emissions.

Gases from this type of operation include carbon dioxide, carbon monoxide, oxygen, and nitrogen [50]. These gases are of little concern to this study because they do not require scrubbing and do not generate waste for disposal.

Electric-arc furnaces also produce metallurgic fumes, and the emission rates range from five to 10 pounds per ton of metal processed [50]. Induction and reverberatory furnaces generate considerably smaller quantities of metallic dusts and depending upon the metal charged and its condition, are often virtually free of this kind of waste.

TABLE III-7

QUALITATIVE SPECTROGRAPHIC ANALYSIS OF TWO SAMPLES TAKEN FROM A BAGHOUSE SERVING A GRAY IRON CUPOLA FURNACE [1,2]

Element	Approx. amount, % Sample A	Approx. amount, % Sample B
Aluminum	0.81	1.0
Antimony	0.24	0.24
Boron	0.050	0.054
Cadmium	0.13	0.064
Calcium	0.16	.025
Chromium	0.022	0.019
Copper	0.42	0.32
Gallium	0.017	0.019
Germanium	0.018	0.015
Iron	6.0	7.5
Lead	17.0	17.0
Magnesium	0.29	0.30
Manganese	1.0	0.81
Molybedenum	0.0068	0.0075
Nickel	0.023	0.022
Potassium	1.5	1.2
Silicon	8.6	15.0
Silver	0.0093	0.0089
Tin	0.41	0.38
Titanium	0.019	0.034
Zinc	7.1	5.9

---

[1] These data are qualitative only and require supplementary quantitative analysis for actual amounts of the elements found to be present.

[2] The source document does not state why the data are described as qualitative in nature.

Source: Reference 50

TABLE III-8

DUST EMISSIONS FROM GRAY IRON CUPOLAS

Process Weight		Dust Emission	
kkg/hr	(tons/hr)	kg/kkg	(lb/ton)
17.73	(19.55)	2.27	(5.5)
16.73	(18.45)	1.57	(3.8)
11.63	(12.82)	6.59	(16.0)
7.62	(8.40)	5.36	(13.0)
6.35	(7.00)	10.89	(26.4)
3.80	(4.19)	6.14	(14.9)
3.72	(4.10)	6.51	(15.8)

Source: Reference 50

Dusts generated by various methods of cleaning castings such as grinding, shot blasting, sawing, cutting, etc. are exhausted to dust collectors. Some may be trapped for reclamation or reuse and the balance is disposed of [27]. This material consists mostly of metals, except when sand or another non-metallic material is used in abrasive cleaning. The types of abrasives used are enumerated under "Forging" below. The sprues, gates, and other protrusions removed from the surface of the casting, which may account for 50 percent of the metal poured, are reused in the foundry [52].

Spent sand is one of the major constituents of the casting waste stream when sand molds and cores are employed. Discarded cores and molds may also contain a binder of some sort such as linseed or other vegetable oils, molasses, or dextrines, or, in current usage, synthetic resins. They may also retain some surface graphite or other lubricants [29,52]. Wastewater produced by wet methods of sand cleaning is usually high in bentonite, a clay used as a binder [52].

Some types of fluxes used in casting generate wastes for disposal. Others decompose or go off as gases [50]. A whole range of materials is used as fluxes which in turn may combine with metal impurities to form other compounds. These are usually skimmed off the surface of molten metal as dross. An example of this is the addition of aluminum fluoride to molten aluminum with smaller quantities of other fluxes such as sodium chloride, potassium chloride, and cryolite [50]. Magnesium fluoride is forged and discarded. Limestone and lime are frequently used in the melting of other metals. Slag, a non-metallic product of the interaction between fluxes and impurities, is an additional waste product along with the water used for quenching slag. Casting is used to such a minor extent in SIC 355 and 357 plants that a more definitive review of the possible compounds or combinations of materials wasted as a result of fluxing is beyond the scope of this study.

Other types of miscellaneous wastes may occur in casting depending on the type of mold used. These include scrap porcelain and plaster. The use of asbestos in the latter is now discouraged by the metals industry [27]. On-site wastewater treatment of foundry wastewater creates sludge which is generally landfilled.

One of the four surveyed plants with ferrous foundries reported disposal of collected particulates. The surveyed nonferrous foundry is equipped with a scrubber. Data on the scrubber water and sludge were compiled. Only one plant reported disposing of dust from its foundry.

Table III-9, reproduced from an earlier EPA report, shows quantities of the various types of wastes generated by iron and steel casting and Table III-10, from the same document, shows waste

TABLE III-9

WASTE FACTORS FOR IRON AND STEEL FOUNDRIES

kg/kkg (lb/ton) of Metal Melted

	Cupolas	Electric Arc Furnaces	Electric Induction Furnaces	Iron (All Types)	Steel	Average Values (For All Furnaces & Metal Categ.)
Refractories	10.0 (20.0)	26.5 (52.9)	7.2 (14.4)	7.7 (15.4)	26.5 (52.9)	18.4 (36.8)
Slag	56.3 (112.5)	60.8 (121.5)	15.8 (31.6)			47.5 (94.9)
Furnace Emissions	10.1 (20.2)	6.0 (12.0)	Neg.			7.7 (15.4)
Pouring & Shakeout						18.2 (36.4)
Cleaning & Finishing				7.8 (15.6)	55.3 (110.5)	19.7 (39.4)
Core Butts						48.1 (96.1)
Waste Sand						300 (659)
Sand Reclamation Dust						31.7 (63.3)
Core Room Sweepings						11.8 (23.6)

Source: Reference 53

TABLE III-10

FOUNDRY WASTE CONSTITUENTS

*All values expressed as $\mu g/g$

	Constituents*									
Waste Type	**Cr**	**Cu**	**Mn**	**Ni**	**Pb**	**Zn**	**Cd**	**Fe**	**Phenol**	**Others**
Refractories										Silica, Fire Clay, Magnesia Dolomite, Caldium Oxides, Alumina, Mullite, Carbon
Slag	17 to 150	18 to 52	760 to 5,200	10	10 to 16	10 to 40	1	40,000		
Furnace Emissions	21 to 100	90 to 300	870 to 19,000	32 to 60	130 to 310	500 to 7000				
Pouring & Shakeout Dust	50	150	375	--	130	250	2.3	29,700		
Cleaning & Finishing Dust	100 to 200	40 to 950	2,060 to 6,700	130 to 150	<10 to 840	20 to 210	2	392,000		
Core Butts										Same as for Core Room Sweepings
Waste Sand	3 to 18	6 to 26	29 to 230	4 to 200	<10 to 400	6 to 7			1.01 to 1.73	
Sand Reclamation Dust	41	7	41	—	15	30	<1	3,000		
Core Room Sweepings										Oils, Phenol Formaldehyde Resins, Sodium Silicate, Phenolic Cyanate, Alkyd Resins, Isocyanate Compound Urea, Furfural Alcohols

Source: Reference 53

constituents [53]. Table III-9 points up the fact that refractory type wastes and cleaning and finishing wastes are higher for steel casting than for iron. The other types of waste do not differ appreciably between iron and steel foundries although there is some variation among furnace types as illustrated in the table. As would be expected, both cupolas and electric arc furnaces produced more slag and emissions than electric induction furnaces.

Table III-11 was derived from an analysis of samples collected from four areas of foundry operations surveyed during this study. The samples are actually combined samples from two foundries on the same premises. One operation is a 14-16 kkg per day (15-18 ton per day) electric furnace handling gray and ductile iron and Ni-hard castings. The other foundry is a 159-kkg per day (175-ton per day) cupola in which gray and ductile iron castings are made.

It readily can be seen that the concentrations of metals detemined by the previous study are generally much greater than those in this contractor's analysis [53]. However, the data base is sufficiently sparse to preclude any supportable conclusions about the differences.

Another significant aspect of the figures in Table III-11 is the extremely low leaching rate of most metals from the foundry wastes. Although actual concentrations in the wastes, were rather high in some cases, the metals concentration in the water leachate was minimal and in most cases undetectable. Because of these tests, corroborated by testing sponsored by the American Foundrymen's Association, foundry wastes are considered nonhazardous.

The following tabulation reviews the foundry distribution in the industries covered by this study as taken from Table II-7.

	Type of Foundry	Total Plants	Total Foundries	% With Foundries
SIC 355	Ferrous	3,590	70	1.95
	Nonferrous	3,590	46	1.28
	Nonferrous Die Casting	3,590	2	0.06
SIC 357	Ferrous	1,140	3	.030
	Nonferrous	1,140	3	0.40
	Nonferrous Die Casting	1,140	3	0.30

TABLE III-11

ANALYSES OF FOUNDRY WASTES
ppm

Origin of Waste	pH	Cd	Cr	Cu	Fe	Pb	Zn	Ni	Mn	
Spent foundry core sand		0.5	10.0	23.0	8,860	28.0	43.0			Raw Samples
from scrap pile	6.4	<0.2	<0.2	<0.2	<1.0	<2.0	<0.2			Leachate
Settled dry sand sludge		<0.2	3.0	6.0	3,440	19.0	7.0			Raw Samples
from wet dust collector	6.9	<0.2	<0.2	<0.2	<1.0	<2.0	<0.2			Leachate
Dryer shake-out sand from		<0.2	4.0	6.0	5,400	3.0	71.0			Raw Samples
paper machines roll coating	8.1	<0.2	<0.2	<0.2	<1.0	<2.0	<0.2			Leachate
Settled bond sludge from wet dust collection in		0.5	32.0	880.0	2,750	51.0	85.0	270.0	350.0	Raw Samples
sand preparation area	11.0	<0.2	<0.2	0.4	<1.0	<2.0	<0.2	0.4	<0.4	Leachate

Source: Contractor analyses

Metal Forging

Metal forging is a process in which metal parts of varying shapes and complexities can be produced by hot-working the metal in dies in which the shape of the desired product has been formed [27].

Metal forgings can be produced from most metals and alloys, but the majority of forgings are made of steel and alloys of copper and aluminum. Forging is almost always done with heated metal to provide the degree of plasticity required to transform the shape of the metal from the incoming bar or flat section to the desired final product configuration. Consequently, the operations involved in the typical forge shop involve cutting the metal into the size or shape required for insertion into the forging dies; heating the cut pieces or slugs in an electric or fuel-fired furnace to the desired temperature; hammering or pressing between dies in a mechanical or hydraulic press to achieve the desired form; and removing the excess metal by punching, shearing, or sawing after forging, the work may be heat treated when required to achieve desired physical properties. It may also be pickled or sand blasted to remove surface oxidation or scale [27,29].

A typical forging operation is shown in Figure III-4.

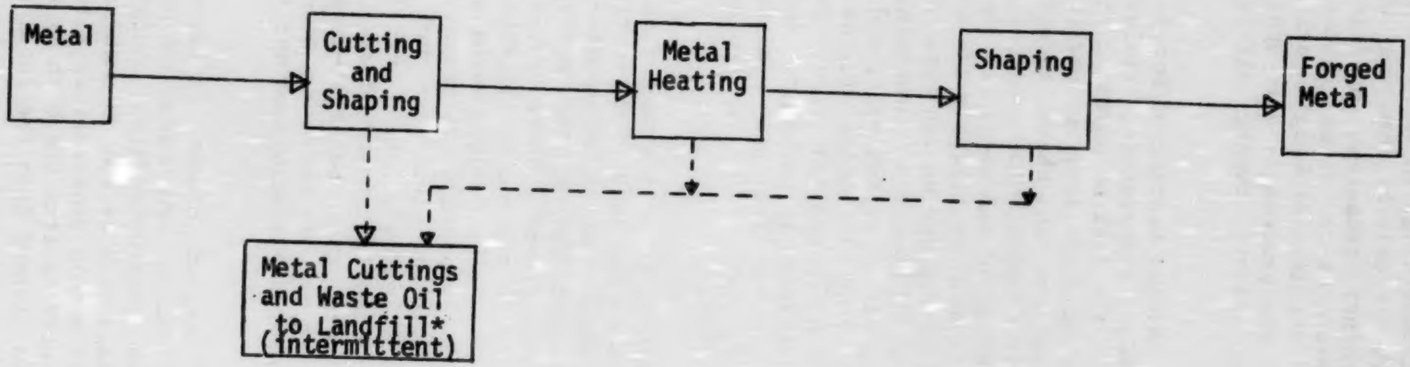
Only one forging operation was found in the surveyed plants which is a hot press aluminum process in an SIC 3552 plant making textile machinery. None were located in randomly selected plants.

Table II-7 shows that only nine SIC 355 plants in the United States have forging operations and there are only three in SIC 357 facilities out of a total of 3590 and 1140 plants, respectively. The percentage of use is 0.27 and 0.26.

The forging process itself produces negligible wastes although there are wastes from the attendant descaling operation such as pickling, salt bath descaling, and abrasion. These operations are described later in this section. Sump oil was the only forging waste reported by the one surveyed plant which engages in forging. It is expected that the generation of this waste will not exceed 100 kg (220 lbs) per plant annually.

Heat Treating

Heat treatment of metals is defined as the process of heating and cooling of a solid metal or alloy in such a way as to obtain desired conditions or properties [29,35]. Heat treating processes include annealing and normalizing, used to reduce or control hardness



Metal
Cutting and Shaping
Metal Heating
Shaping
Forged Metal
Metal Cuttings and Waste Oil to Landfill* (Intermittent)

* Negligible process waste generated.

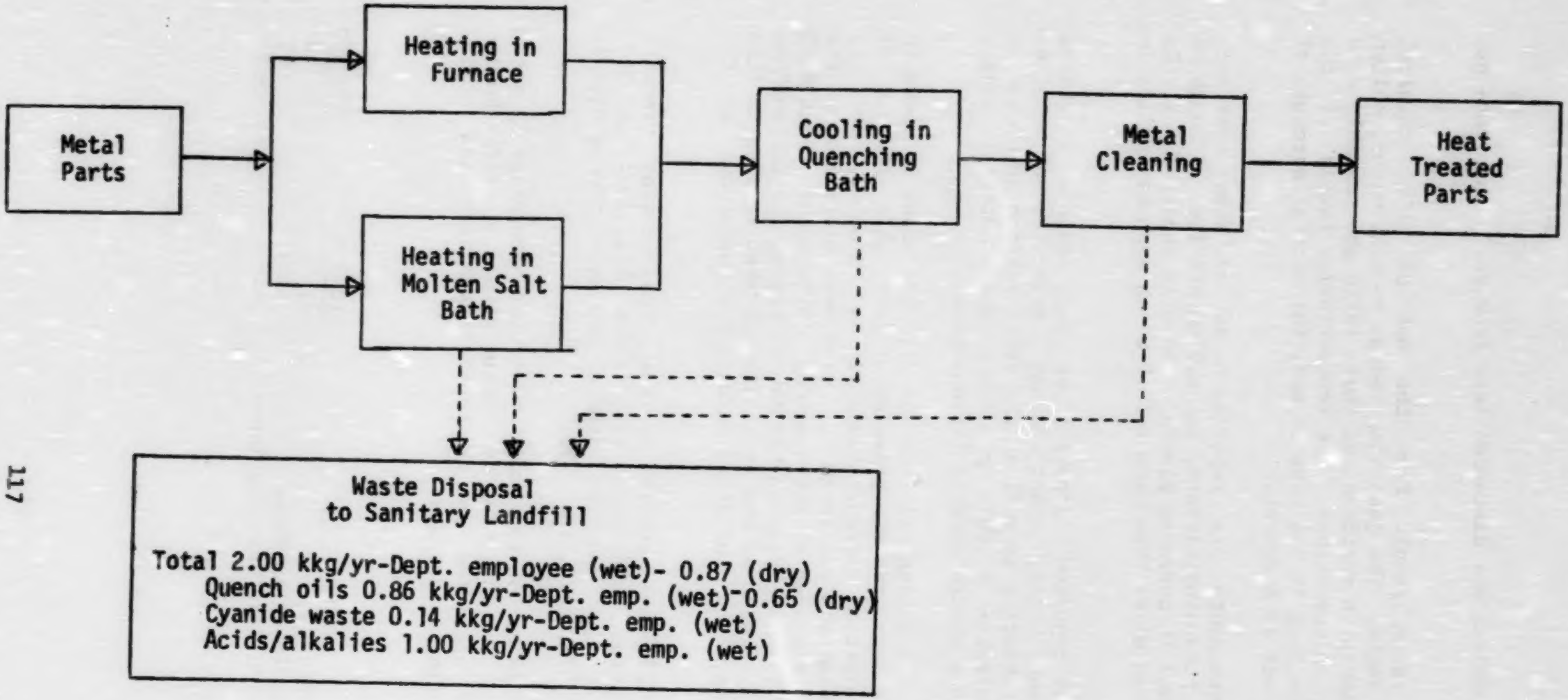
FIGURE III-4

SIMPLIFIED TYPICAL METAL FORGING OPERATION in hot or cold worked metals; hardening by heating and quenching of certain metals, principally steels; carburizing, in which carbon is introduced into the surface of low carbon steels by heating them in carbon-rich media followed by quenching; tempering or drawing in which metals are heated at low temperatures for stress relieving or to modify the hardness of quenched steels. Although steel is the principal metal which is heat treated, the process is also applied to some grades of cast iron, aluminum alloys, copper alloys, and magnesium alloys.

Heat treating operations always involve heating of metals under controlled conditions to a prescribed temperature, followed by cooling at a rate required to result in the desired physical property in the part being heat treated. Heating operations are performed in a variety of batch or continuous furnaces in which reducing or oxidizing atmospheres may be present to control the rate of carbon introduction or elimination from the metallic surfaces; or they may be performed in liquid heating media such as molten salts or lead. The type of heat treating process used depends on the type of metal involved and the specific properties to be rendered. Quenching media include such liquids as water, brine, oil, molten salt, and molten lead. For some operations cooling is done in still air, or in the furnace by reducing the temperature at a controlled rate. Parts to be heat treated are often cleaned by washing in alkaline solutions before heating, and are generally cleaned after heat treatment by washing, shot blasting, or pickling in acids. A typical heat treating operation is shown in Figure III-5.

The most common toxic substance used in heat treating is molten salt containing cyanide. This is commonly used for heating and surface hardening of steels. Although little information exists regarding the prevalence of this operation, it is the contractor's experience that about half of the heat treating shops have salt pot heating equipment, although less than 10 percent of all steel which is heat treated is heated in salt baths. The cyanide baths are only used when direct heating methods will not provide the proper surface properties. During the plant survey visits, plant personnel advised that the cyanide-free, or "neutral salts", are satisfactory substitutes for cyanide salts in many applications. However, they have found that some types of metal parts must be heat-treated in cyanides to assure adequate hardness to prevent premature cracking or breaking. A "neutral salt" manufacturer's bulletin does not identify the specific ingredients used [54].

The wastes from heat treating consist almost exclusively of metal salts, the most important of which are sodium and potassium cyanide. Bath solutions of these compounds also contain some quantities of nonhazardous materials such as sodium carbonate and sodium chloride. The waste salts are mainly generated as a result of drag-out; that is, the salt is carried from the bath by the work piece and either falls away or is cleaned from the metal surface.


Metal Parts
Heating in Furnace
Heating in Molten Salt Bath
Cooling in Quenching Bath
Metal Cleaning
Heat Treated Parts
Waste Disposal to Sanitary Landfill
Total 2.00 kkg/yr-Dept. employee (wet)- 0.87 (dry)
Quench oils 0.86 kkg/yr-Dept. emp. (wet)-0.65 (dry)
Cyanide waste 0.14 kkg/yr-Dept. emp. (wet)
Acids/alkalies 1.00 kkg/yr-Dept. emp. (wet)

Note: These wastes are considered potentially hazardous by the contractor.

FIGURE III-5

SIMPLIFIED TYPICAL HEAT TREATING OPERATION
(26 employees)

The salt baths themselves are discarded less frequently than once per year.

Other spent salts result from the use of other chemical compounds for salt baths. The quenching medium — oil, water, molten salt, or brine — contains residues of these salts and possibly some solvent from cleaning operations. The concentration levels of the medium depend on how long it has been in use, the initial strength of salt baths, and amount of drag-out.

Molten salt quenchants are reported to include substances such as sodium nitrate, potassium nitrate, and sodium nitrite, although no use of them was found in surveyed plants. The oils employed for this purpose are described under "Raw Materials," which appears earlier in this section.

Surveyed plants reported disposing of salt baths, including cyanide baths, quench oils, spent coolants, solvents, and alkaline cleaners from heat treating as well as the still bottoms generated in reclaiming spent solvents in this process. These materials render heat treating process wastes potentially hazardous.

The analysis of a quench oil from an SIC 3574 plant is shown in Table III-12. This indicates the presence of less than 10 ppm of cyanide, a not unexpected concentration. It may be noted, however, that this particular oil reservoir has never been discarded by the plant. Drag-out is replaced by fresh makeup. Altogether, about 0.97 kkg/year-dept. employee of total wastes are generated for disposal on a sanitary landfill. Based on the criteria described earlier in this section, these wastes are considered potentially hazardous by the contractor.

Eleven of the 33 plants covered by the field survey practice heat treating operations. One plant each in SIC 3552, 3554, and 3555 engages in heat treating and the others are about evenly divided between SIC 3572, 3573, 3574, and 3579.

Heat treating is one of the most widespread processes in metal working industries. The following tabulation gives the distribution of heat treating operation in the special machinery and office machines manufacturing industries:

	SIC 355	SIC 357
Total Plants	3,590	1,140
Total Heat Treating Shops	159	42
Percent with Heat Treating Shops	4.4	3.7

TABLE III-12

LABORATORY ANALYSIS OF A HEAT TREATING QUENCH OIL FROM AN SIC 3574 PLANT

		ppm						
	pH	Cd	Cr	Cu	Fe	Pb	Zn	CN
As Received		<0.1	<0.1	<0.1	<0.5	<0.5	<0.1	<10
As Water Leached	8.0	<0.02	<0.02	<0.06	0.4	<1.0	0.16	

Source: Contractor analyses

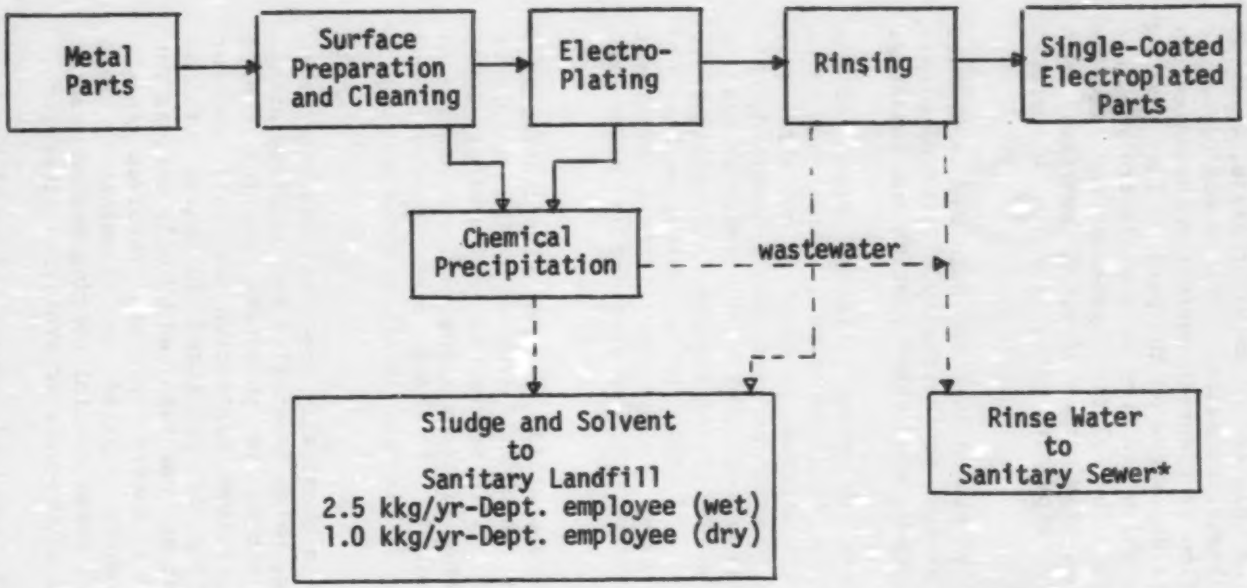
Electroplating and Etching

Electroplating is a process in which an adherent metallic coating is electrodeposited upon an electrode (or part being plated) to obtain a surface with properties or dimensions different from those of the basis metal, the material on which the coatings are deposited [30]. The purposes of electroplating include deposition of coatings which will provide corrosion or wear resistance, or which will improve the appearance of an article. Plating is also used to restore worn parts to original dimensions and to deposit hard coatings on tools to improve tool life.

Many metals can be used for electroplating. They include copper, chromium, nickel, zinc, tin, cadmium, lead, iron, gold, silver, rhodium, and alloys of tin and other metals. Almost any metallic surface can be plated, and, in addition, certain nonmetallic materials such as plastics can be plated [30].

The electroplating process, shown in Figure III-6, involves a number of steps or operations, some of which take place both before and after the actual plating operation. The typical ones are described in the following paragraphs:

Surface Preparation and Cleaning - The surface of parts to be plated must be finished to the degree desired for the intended final use. The plating material will not fill cracks, scratches, pin-holes, machining marks, welding beads, or other defects, but will uniformly coat all surface discontinuities. Therefore, surface preparation by polishing, buffing, or brushing may be necessary before plating. The surface must also be clean. This requires removal of any surface films of oil, grease, polish, grit, rust, oxidation, or other material by solvent degreasing, alkali washing, or acid pickling. In some cases, electropolishing is performed to electrochemically remove all surface material and to prepare the parts for plating [30,31]. When pickling solutions are used alone for surface preparation, they are strong solutions of sulfuric or hydrochloric acid (seven to 12 percent of sulfuric acid, for example); when used as a stage of scale removal in conjunction with operations such as abrasive descaling, concentrations of three percent acid are more typical [29]. As these solutions accumulate sufficient quantities of metal compounds to reduce their efficiency, they are either dumped to sewer or reprocessed. While dumping is currently the prevalent practice, reprocessing is becoming more and more commonplace [43]. One source indicates that acid use for pickling ranges from about 4-20 kg/kkg (10-50 lb/ton) of metal [43]. In addition, forgings deposit drag-out of the pickle liquor in the rinse waters, thus creating another dilute waste. The same source estimates the volume of rinse water from about 209-418 liters/kkg (50-100 gallons per ton) of metal pickled [43]. Metal loss through scaling is usually about three to five percent [29].


Metal Parts
Surface Preparation and Cleaning
Electro-Plating
Rinsing
Single-Coated Electroplated Parts
Chemical Precipitation
wastewater
Sludge and Solvent to Sanitary Landfill
2.5 kkg/yr-Dept. employee (wet)
1.0 kkg/yr-Dept. employee (dry)
Rinse Water to Sanitary Sewer*

*Due to pending EPA effluent, guidelines, rinse water discharge to sewers may be prohibited in the future. This wastewater generation rate presently amounts to 1.0 kkg/yr-Dept. employee.

NOTE: Wastes are considered potentially hazardous by the contractor.

FIGURE III-6

SIMPLIFIED TYPICAL ELECTROPLATING OPERATION
(44 employees)

After pickling, metalwork is normally dipped in a water rinse tank.

Electroplating - The electroplating operation itself involves the immersion of the parts to be plated in an electrolyte, which is an aqueous solution of acids, bases, or salts. The electrolyte is capable of conducting the flow of electric current accompanied by movement of the material to be deposited on the part. The plating metal may come from cathodes which are hung in the electrolyte, or from the electrolyte itself. The plating process may involve deposition of a single metal, or a series of metal deposits. Each metal must be deposited in a separate tank, and in a separate operation.

Dipping of the pieces to be plated into the bath may be carried out manually, automatically, or semi-automatically. Surveyed plants reported use of barrel, still, rack, and basket plating and tumbling.

Etching is a special process in which selected areas of the surface of a part are removed by acid treatment. Areas not to be etched are masked by printing the desired pattern on the surface of the part. Although an exact percentage has not been determined, this process is commonly used for manufacturing printed circuit boards in SIC 3573 and 3574. Equipment and processes are generally similar to those used for electroplating. Bright dipping, which, as the term implies, produces a bright surface, is another surface treatment encountered in the plant surveys. A copper-tin-zinc alloy was employed.

Electroless plating is the deposition of a metallic coating by a controlled chemical reduction which is catalyzed by the metal or alloy being deposited [30,31]. This process is less commonly found in SIC 355 and 357 plants than electroplating, and was present in only three was the plants visited. In each case, production of printed circuits was involved. Tin is used in one process and copper in the other two.

Black oxide coating is a chemically deposited coating, also known as a conversion coating, which is similar to electroplating. Another chemically deposited coating is phosphate coating. Both processes are used for corrosion protection as well as for appearance. Black oxide coating is practiced in three of the surveyed plants; phosphate coating was reported by only one, as was the case with anodizing. The latter process involves anodic oxidation and is most frequently applied to aluminum. This industry-wide implementation of these special coating methods cannot be accurately assessed from the survey data or available literature.

Post Treatment - After the required amount of metal has been deposited, the parts being plated are removed from the plating solution and are rinsed in one or more successive baths. This is done after each plating operation in cases where more than one coating is plated on a part. Both reclaimable rinses and continuous overflow rinses are employed [32]. Final electroplating treatment involves drying of the finished pieces, either by air drying or forced drying methods.

Nine electroplating operations were found in the 33 plants surveyed, only one of which was in a randomly selected plant. The total number of electroplating operations reported by the Census in these industries and percentages of use are as follows:

	SIC 355	SIC 357
Total Plants	3,590	1,140
Total Electroplating Shops	33	53
Percent with Plating Shops	0.92	4.65

In the special machinery manufacturing industries, electroplating wastes are generally in a liquid form, but since many of them are prohibited from entry into municipal sewers and they are small in quantity, they may be drummed for deposit in a landfill. The most important constituents of electroplating wastes are acids and metals such as chromium, zinc, copper, nickel, iron, and cyanides in solution, either as simple ions or as cyanide complexes [46]. The presence of these metals were confirmed by the analytical tests.

While some plating solutions may be restored with make-up chemicals and are discarded only after a long period of use, others are dumped with more regularity. During the survey visits, it was found that solutions were changed every six weeks in one case, but less than once a year in another case. The concentrations of metals and cyanides in plating baths and in the first rinse water are shown in Table III-13 [46]. Subsequent rinses are, of course, more dilute.

The concentrations of the rinses are a direct function of the degree of drag-out which is illustrated in Table III-13. The percentage of drag-out varies with plating method — the volume may be larger in barrel plating than soak plating, for example, and manual operations usually produce larger losses than automatic systems — the size and shape of the objects plated, drainage time, recovery efficiency, and other factors [43]. The liters-per-hour (gallons-per-hour) drag-out figures used in Table III-13 — 1.9 LPH and 9.5 LPH (0.5 GPH and 2.5 GPH) — represent averages for plating small and large objects respectively.

Pre-cleaning wastes account for a significant portion of the electroplating waste stream. These are most frequently organic solvents acod pickling baths, and alkaline cleaners.

TABLE III-13

COMMON PLATING BATHS

Bath Formula in gm/liter (oz/gal)	Metallic + Cyanide Concentrations in ppm	Rinse Concentration in ppm[1] 1.9 lph(0.5gph)[3] Drag-out[2]	Rinse Concentration in ppm[1] 9.5 lph(2.5gph)[3] Drag-out[2]
Nickel nickel sulfate, 300 (40) nickel chloride, 60 (8) boric acid, 45 (6)	82,000 Ni	171 Ni	855 Ni
Chromium chromic acid, 397 (53) sulfuric acid, 4 (0.53)	207,000 Cr	431 Cr	2,155 Cr
Copper (acid) copper sulfate, 203 (27) sulfuric acid, 49 (6.5)	51,500 Cu	107 Cu	535 Cu
Copper (cyanide) copper cyanide, 22 (3.0) sodium cyanide, 34 (4.5) sodium carbonate, 15 (2.0)	12,400 Cu 28,000 CN	2.8 Cu 58 CN	14 Cu 290 CN
Copper (pyrophosphate) copper (as proprietary mix), 30 (4) sodium pyrophosphate, 217 (29)	30,000 Cu	62 Cu	310 Cu
ammonia (by volume) 0.4%	--	--	--
Cadmium cadmium oxide, 26 (3.5) sodium cyanide, 108 (14.5)	23,000 Cd 57,700 CN	48 Cd 120 CN	240 Cd 600 CN
Zinc zinc cyanide, 60 (8) sodium cyanide, 42 (5.6) sodium hydroxide, 75 (10)	33,800 Zn 48,900 CN	70 Zn 102 CN	350 Zn 510 CN
Brass copper cyanide, 30 (4) zinc cyanide, 10 (1.25) sodium cyanide, 57 (7.5) sodium carbonate, 30 (4)	21,000 Cu 5,250 Zn 47,500 CN	44 Cu 11 Zn 99 CN	220 Cu 55 Zn 495 CN

TABLE III-13 (Cont.)

COMMON PLATING BATHS[1]

Bath Formula in gm/liter (oz/gal)	Metallic + Cyanide Concentrations in ppm	Rinse Concentration in ppm[1] 1.9 lph(0.5gph)[3] Drag-out[2]	Rinse Concentration in ppm[1] 9.5 lph(2.5gph)[3] Drag-out[2]
Tin (alkaline, sodium stannate, 119 (16) sodium hydroxide, 8 (1) sodium acetate, 14 (2)	53,000 Sn	110 Sn	550 Sn
Silver (cyanide) silver cyanide, 30 (4) sodium cyanide, 30 (4) sodium carbonate, 45 (6)	24,600 Ag 21,800 CN	51 Ag 45 CN	255 Ag 225 CN

Source[1] Excerpted from Industrial Wastes, W. Rudolfs, Ed., Reinhold Publishing Corp., New York, 1953.

[2] "Drag-out" is the amount of solution carried out of the bath by the material being plated and the racks holding the material.
Rinse rate is assumed to be 14.2 lph (4 gpm).

[3] lph = liters per hour
gph = gallons per hour

The waste solvents from degreasing may contain residues of machining oil, metal chips, quenching oil, stamping oil, waxes, or other lubricants, depending upon the process used to manufacture the part being degreased and the type of plating to be performed. The exact quantities for each of these constituents could not be ascertained during the study. As discussed previously, a whole range of aliphatic hydrocarbons, chlorinated hydrocarbons, alcohols, acetone, and toluol are commonly employed for degreasing. The additives in the oils used for different purposes may vary or the oils may be pure mineral oil or an unaltered animal or vegetable oil.

Alkaline cleaners also remove oil and grease, as well as pigmented drawing compounds, chips and cutting fluids, polishing and buffing compounds, and rust and scale [34]. The residues contained in discarded cleaners thus vary with type of use. Caustic concentrations vary with original make-up of the cleaning solution, length of use, and synergistic effect of soils on solution constituents. These cleaning solutions are amenable to make-up additions of constituent compounds, and the frequency of discard is highly variable. The concentrations of the rinses are also dependent on the above factors as well as on percentage of drag-out.

Acid pickling waste concentrations — sulfuric, hydrochloric, or nitric — used for electroplating pretreatment are usually one to five percent [46].

Similar pretreatment wastes are generated in etching. The most common etching solutions contain ferric chloride or nitric acid. For copper etching on printed circuit boards in SIC 357, ferric chloride, sodium and ammonium persulfate, chromic acid, and cupric chloride (31] are used. The spent etchants and rinse waters also contain residues of the basis metals.

On-site treatment of plating and etching wastes precipitates the metals and the resulting sludge requires land disposal. These sludges are typically disposed in a sanitary landfill.

The plating wastes reported by surveyed plants which engage in this practice are consistent with the above description. They include acid and alkaline baths, cleaning tank metals, plating tank sludge, chemicals from rinse tanks, and solid waste from equalization tanks. Three sludges from the treatment of plating wastes from an SIC 3574 plant were analyzed. These were derived from treatment of an ammonia stream, a general stream, and a cupric oxide stream. The results are shown in Table III-14. Detectable concentrations of chromium, copper, iron, lead, and zinc were found, copper and iron being the most abundant. No detectable quantities of cadmium were found in the wastes. In general, after water leaching of the samples, no detectable amounts of metals were extracted into the leachate. The main exception was the copper oxide sludge which

TABLE III-14

ANALYSES OF SLUDGES FROM TREATMENT OF ELECTROPLATING WASTES

Stream	pH	% Water	Heavy Metals Concentration, ppm								
			Cd	Cr	Cu	Fe	Pb	Zn	Ni	Mn	
SIC 3574:											
Ammonia	11.8	98	<0.1	0.4	138	25	<0.5	2.5			As Received
	9.1		<0.02	<0.02	0.08	0.6	<1.0	<0.02			As Water Leached
General	12.3	100	<0.02	<0.02	1,373	37	0.5	14			As Received
	10.0		<0.02	0.02	0.6	0.8	<1.0	<0.02			As Water Leached
Copper Oxide	7.5	40	<0.1	4	284,000	16,600	<10	680			As Received
	7.3		<0.08	<0.06	8	<0.4	1.0	0.6			As Water Leached
SIC 3572 and 2579:											
Chrome & Cyanide Rinses; Acids caustics*	7.9		21	7,350	480	2,410	11	2,756	2,830	110	As Received
			<0.02	0.06	0.2	<0.08	1.0	0.30	0.6	0.4	As Water Leached

* This plant also manufactures products falling within several other SIC categories.

Source: Contractor analyses

yielded 8 ppm of copper, 1 ppm of lead, and 0.6 ppm of zinc.

The value of the initial copper content of the copper oxide stream is sufficiently unusual to question the validity of the sample. It was anticipated that the sludge would contain only an inert copper hydroxide; instead the analysis showed 284,000 ppm Cu of a copper oxide. This company recovers, through various contractors, all feasibly and economically reclaimable metals, and it is felt that the loss represented by this sample reflects an abnormal situation.

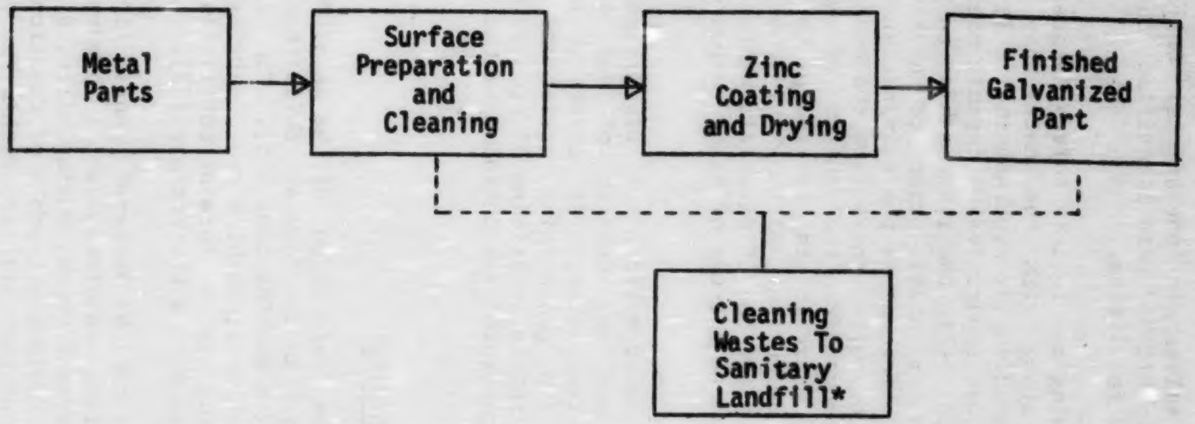
Table III-14 also shows the analytical results on sludge from treatment of an electroplating waste in a plant which makes both SIC 3572 and 3579 products. Detectable levels of cadmium, chromium, copper, iron, lead, zinc, nickel, and manganese were found. Chromium, iron, zinc, and nickel were all found in concentrations above 2000 ppm, although water leachate from this sludge did not contain more than 1.0 ppm of any of the heavy metal constituents listed above. Still, electroplating wastes are considered potentially hazardous.

As noted earlier, the sludge from electroplating wastes normally is drummed and shipped by private contractor to a landfill operation — usually described by plant personnel as a sanitary landfill. On the other hand, waste rinse water is normally discharged to plant sewers and are piped to municipal sewage treatment plants. Due to pending EPA effluent guidelines pertaining to electroplating wastes, it is possible that electroplating rinse water waste discharge to sewers may be prohibited in the future. Assuming that this will be the case, approximately 1.0 kkg/yr-dept. employee on a wet basis and 0.8 kkg/yr-dept. employee on a dry basis of chemically treated sludge from electroplating operations will be generated.

Hot Dip Galvanizing

Galvanizing is the deposition of zinc or alloys of zinc on the surface of steel parts. This process includes electrogalvanizing and hot dip galvanizing. The electrogalvanizing process is very similar to electroplating.

Hot dip galvanizing involves operations in which the parts are prepared as needed for dipping and then zinc coated as shown in Figure III-7. The pretreatment operations can include washing in alklaine solutions, pickling in acid to remove surface oxide or scale, and fluxing by dipping in a bath of zinc ammonium chloride [33]. The exact pretreatment applied will depend on where the metal work comes from and the degree of post treatment received from other operations. After drying (usually in air), the parts are immersed in a molten bath of zinc to which certain alloys have been added. Parts removed from the zinc pot are drained and cooled using air or water [34].


Metal Parts
Surface Preparation and Cleaning
Zinc Coating and Drying
Finished Galvanized Part
Cleaning Wastes To Sanitary Landfill*

*Negligible quantities of wastes are generated by this process.

FIGURE III-7

SIMPLIFIED TYPICAL HOT DIP GALVANIZING OPERATION

None of the surveyed employ galvanizing operations. Only eight plants in SIC 355 and two plants in SIC 357 were identified in Table II-7 as having hot dip galvanizing facilities.

The waste stream for galvanizing may include solvent degreasers, alkaline baths, and pickling acid along with the metal they remove from the surface of objects cleaned during pretreatment. It also could contain fluxes used to remove impurities — organic matter or iron salt or finely divided iron — in the zinc bath or to finish cleaning impurities from the iron or steel prior to galvanizing. Dross, an alloy of iron and zinc formed in the galvanizing pot by iron salt or finely divided iron deposited there from the surface of imcompletely cleaned pieces, is removed from the bottom of the bath or skimmed from the top [33,34,50] where it is carried by the flux. Zinc ammonium chloride is a common flux, although air pollution control benefits to be derived from the use of materials which do not share its fuming tendency may promote the use of other compounds in the future [33,34,50].

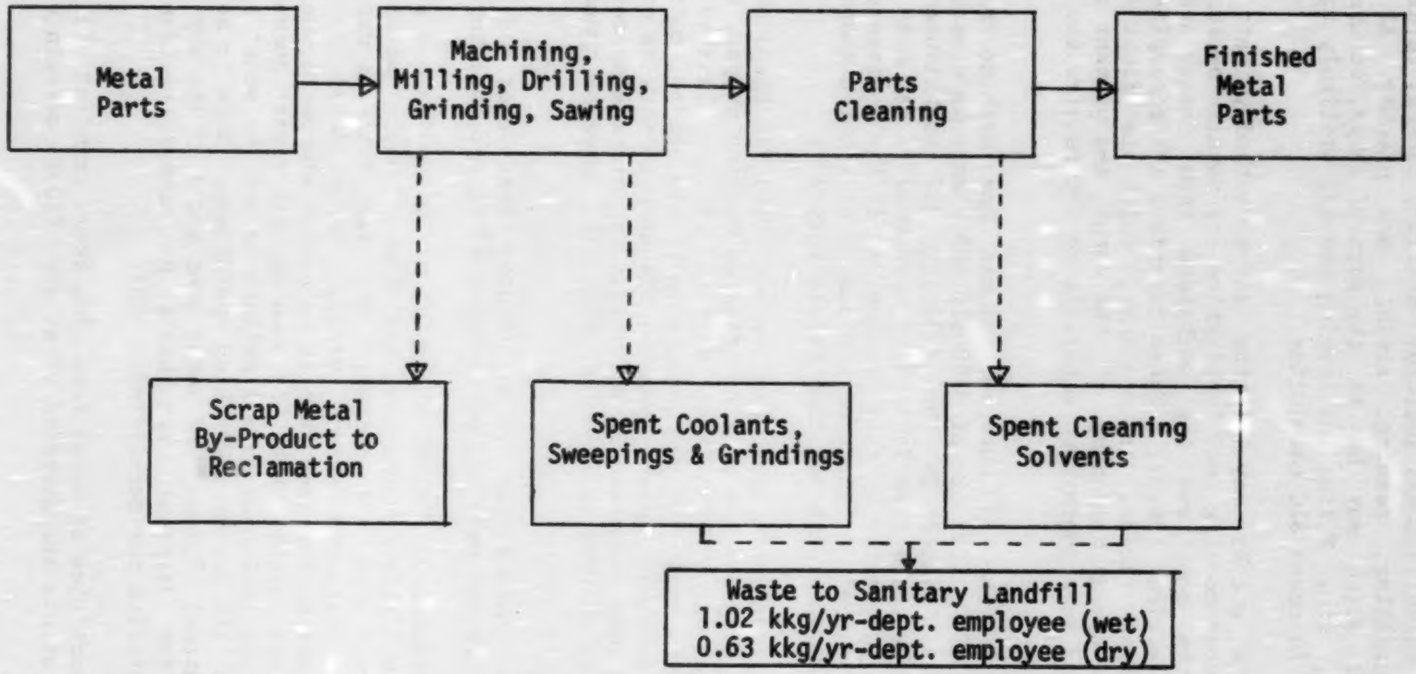
The generation of process wastes from hot dip galvanizing operations will be intermittent, and may consist of any of the materials described above at any given time. It appears, in the contractor's judgment, that hot dip galvanizing operations within these two industries generate negligible quantities of process waste. Those cleaning wastes which are generated are included in the wastes from other unit processes.

Machining

Machining, according to the definition of the metal working industry, is the removal of material in the form of chips from metal parts, usually through the use of a machine tool [35]. The factors involved in machining are the workpiece, machine tool, cutting tool, and cutting fluid [36]. Grinding is a form of cutting in which abrasive grains in a grinding wheel act as the cutters [37].

The machine shop equipment used by surveyed plants includes: engine and turret lathes, milling machines, drill presses and electric drills, grinders of several types, boring mills, planers, and hand and cut-off saws. These tools are capable of functions with a wide variety of nomenclature but they all fall within the general category of cutting and shaping in one manner or another. Several machining operations are often carried out in conjunction with each other and many pieces of equipment are capable of performing more than one machining function. A typical machining process is shown in Figure III-8.

Examples of the machining operations which are common to many


Metal Parts
Machining, Milling, Drilling, Grinding, Sawing
Parts Cleaning
Finished Metal Parts
Scrap Metal By-Product to Reclamation
Spent Coolants, Sweepings & Grindings
Spent Cleaning Solvents
Waste to Sanitary Landfill
1.02 kkg/yr-dept. employee (wet)
0.63 kkg/yr-dept. employee (dry)

Note: These wastes are considered potentially hazardous by the contractor.

FIGURE III-8

SIMPLIFIED TYPICAL MACHINING OPERATION
(16 employees)

SIC 355 and 357 establishments include: milling, facing, turning, grinding, boring, drilling, reaming, sawing, and planing. All of them remove metal which may be in the form of chips, turnings, grindings, borings, etc. Filing and lapping are not as likely to be as widely employed in these SIC categories.

When metal is cut by any of the above methods, heat is generated. Continuous cooling and lubrication are usually necessary to protect both the tool and the workpiece from damage and to facilitate cutting action [36,37]. These functions are accomplished by the use of cutting fluids, or coolants, which also flush away metal chips, reduce strain hardening of the metal, and prevent rust [37]. Cast iron and some nonferrous materials do not require the use of cutting fluids.

Twenty-eight of the 33 surveyed plants have machine shops. According to Table II-7, 1201 out of 3590 SIC 355 plants have machine shops and 172 are located in the 1140 SIC 357 establishments. Although the Census data from Table II-7 were used to estimate the quantities of waste generated by this process, it is the contractor's opinion that the Census' estimate of the number of machine shops in the special machines manufacturing industry is very low.

Ten surveyed plants maintain their own tool and die shops which for all practical purposes can be classified as machine shops. Some tool and die shops occupy the same portion of the plant as the machine shop and are used for maintenance only. In others, cutting tools are made or serviced in the tool and die shop to service other plant operations. This procedure is in itself a machine operation and cannot be separated from the machine shop in terms of types of wastes produced.

It was found during the survey visits that water and air pollution control systems were not generally used in machine shops.

The waste stream from a machine shop is not a complex one since machining is essentially a mechanical operation. Waste metal is generated in numerous sizes and shapes. The larger pieces may for the most part be considered "scrap" metal. Scrap metal is not usually a "waste" due to the fact that it is nearly always recovered. The term "particulate metal" which is used in this report generally means the metal dusts collected as air pollutants and the metal fines from grinding and similar metal working operations. This is not to say that an occasional "piece" of metal does not find its way into the general trash for disposal, but this is not common practice and can neither be qualified nor quantified.

The smaller particles of metal resulting from grinding, filing, and similar operations are disposed of as dry floor sweepings or mixed with cutting oil (swarf). The metals involved may be used for components of industrial machinery, computer, and office equipment and would include iron, steel, aluminum, bronze, chromium, and many others.

The cooling/cutting oils finally disposed of are generally about 20:1 or 25:1 water to oil solutions which may contain small quantities of any of the above metals as grindings or small chips, machining ink, and general soil absorbed from surrounding plant operations. The additives used in oils employed for this purpose are described under Raw Materials.

Table III-15 shows the laboratory results obtained on five samples of used cutting oils and one fresh sample taken from SIC 355 plants. One sump oil sample is included for comparison; it contained waste oil from both forging and machine shop operations. Although none of the samples exhibited a low flash point, all the samples contained detectable levels of several heavy metals including cadmium and lead. An interesting feature that this table shows is the small quantities of metals water-leached from some rather high initial concentrations. There is no information available to explain the high concentration of lead, 260 ppm, in the first sample listed. It leached at only 1.0 ppm. This sample and the fresh sample came from the same plant and are the same plant and are the same grade and brand name of oil, though probably not from the same supply. There is also no information to explain why the zinc levels are several times higher in the fresh samples than in the used oil.

Table III-16 shows the analysis of (1) a degreaser solvent sample from an SIC 3553 plant machine shop; and (2) a waste degreaser from a combined heat treating, machine shop, tool and die shop, fabrication, and stamping operation of an SIC 3552 plant. The latter contained about 45 percent trichloroethylene and nearly 55 percent of another solvent which was not identified. The pH of the first sample is significantly higher than that of Sample 2, even after water-leaching. This could be explained by the fact that it was used to degrease parts which had previously been subjected to an alkaline treatment, a common occurrence. Detectable concentrations of chromium, copper, iron, lead and zinc were found in both samples, iron being the most abundant. The initial concentrations of metals in the two samples are very similar except in the case of iron. The leaching concentrations are not fully comparable since Sample 1 was 93 percent water and the trichloroethylene in Sample 2 is not miscible with water.

Table III-17 shows (1) the analysis of waste metals of various shapes and sizes which had been deposited on an on-site ridge of land along with soil clinging to the metal; and (2) soil taken from the valley below the ridge at a distance of six to eight feet. The concentrations of metals are high — 500 ppm of Cr, 8700 ppm of Cu,

TABLE III-15

LABORATORY ANALYSIS OF HEAVY METALS IN SPENT AND FRESH CUTTING OILS FROM SIC 355 MACHINE SHOPS

Source	pH	% Water	Flash Point °C(°F)	Heavy Metals Concentration, ppm Cd	Cr	Cu	Fe	Pb	Zn	
Tank on turning lathe	4.8	--	No Flash	0.3	0.1	109	18	260	9	As Received
	6.1			0.08	<0.02	2	2.2	<1.0	2.6	As Water Leached
Grinder tank	8.0	96	No Flash	<0.1	0.1	0.2	10	<0.5	0.5	As Received
	8.2			<0.02	<0.02	<0.06	0.6	<1.0	0.4	As Water Leached
Central coolant system filter sludge		5.8	--	0.4	1,340	1,820	112,660	67	122	As Received
	8.4			<0.2	<0.2	<0.2	<1.0	<2.0	<0.2	As Water Leached
Grinder tank oil		3.1	--	1.5	140	45,300	253,100	2,275	7,608	As Received
	6.4			<0.2	<0.2	0.2	38	<2.0	1.0	As Water Leached
Grinder tank oil	7.9	--	102 (215)	0.2	3	6	156	5	4	As Received
	8.4			<0.04	0.04	<0.08	16	<1.0	<0.04	As Water Leached
Sump oil* from forging & machine shop	8.1		64 (145)	1.1	18	27	280	250	230	As Received
	8.0	35		<0.04	0.04	0.14	1.6	1.4	3.4	As Water Leached
Fresh cutting oil	**	--	No Flash	<0.1	<0.1	1.3	1.7	1.6	40	As Received
	6.8			<0.04	0.04	<0.08	1.0	<1.0	1.6	As Water Leached

* Not cutting oil. ** This sample came from the same plant as the first sample in the column. It was the same grade and brand name, but probably not from the same supply.

Source: Contractor analyses

TABLE III-16

LABORATORY ANALYSIS OF DEGREASER SOLVENT SAMPLES FROM SIC 355 MACHINE SHOPS

Sample	pH	% Water	Flash Point °C(°F)	Heave Metals Concentration, ppm						
				Cd	Cr	Cu	Fe	Pb	Zn	
1	13.2	93	No	<0.1	0.9	2.8	55	1.2	3.6	As Received
	11.8		Flash	0.02	0.6	1.4	20	1.0	1.6	As Water Leached
2	5.5	<0.2	27(1)	<0.1	0.5	1.1	40	1.3	3.0	As Received
	6.0		(81)	0.06	0.04	0.2	1.0	4.0	3.6(2)	As Water Leached

---

[1] This is the flash point of a solvent which accounted for about 55 percent of the sample; trichloroethylene, which made up the balances of the sample, does not flash.

[2] This is within margin of error of analysis method.

Source: Contractor analyses

TABLE III-17

ANALYSES OF METAL SHAVINGS AND SOIL FROM ON-SITE DISPOSAL AT SIC 3554 PLANT

Sample	pH	Heavy Metals Concentration, ppm						
		Cd	Cr	Cu	Fe	Pb	Zn	
Metal Shavings and soil	6.6	1.1	500	8,700	458,700	320	588	As Received
		<0.2	<0.2	<0.2	<1.0	<2.0	<0.2	As Water Leached
Soil from lower elevation, 6-8' distant	6.7	0.2	3	4	2,540	10	31	As Received
		<0.2	<0.2	<0.2	16	<2.0	0.2	As Water Leached

Source: Contractor analyses

etc. — although it could not be established whether the metals had migrated into the soil itself. This isolated instance is not conclusive without additional soil samples to establish background concentrations in the area of the metals. However, it does tend to indicate that some leaching may have occurred. Leaching tests performed in the lab, as shown in Table III-17, indicated that very little leaching occurred, although iron and zinc proved leachable in distilled water to some extent.

Due to the presence of oils, solvents, and metal swarf, machining wastes are considered potentially hazardous. Spent coolants, sweepings, and grindings are generated at an average rate of 0.76 kkg/yr-dept. employee on a wet basis. Spent solvents destined for disposal on land are produced at 0.20 kkg/yr-dept. employee on a wet basis. The total process waste generated from machining operations is thus about 0.96 kkg/yr-dept. employee on a wet basis (0.62 kkg/yr-dept. employee on a dry basis). This material is disposed on a sanitary landfill in most cases.

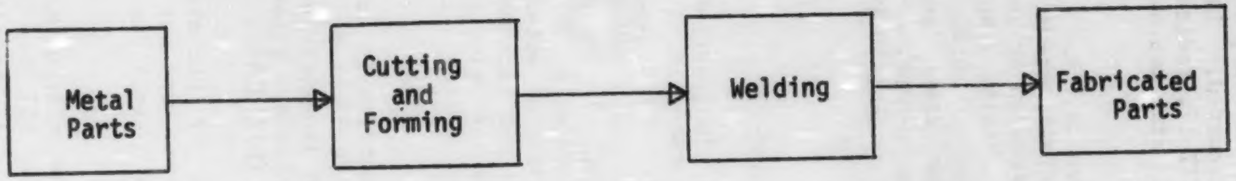
Plate or Structural Fabrication

Twelve of the 13 plate or structural fabrication operations encountered in the 33 plant surveys are located in SIC 355 plants. This process is illustrated in Figure III-9. These activities may include metal cutting and/or other machining, heat treating, and forming, and they culminate in the joining of component product pieces. Welding is extensively employed. Welding is defined, for purposes of this study, as joining two pieces of metal by applying heat, pressure, or both, with or without a filler material [35]. The energy for welding may be supplied by gas or electricity. The surveyed plants listed spot, arc, and heliarc welders as being in use.

One major use of welding in these industries is fabrication of machinery housings or frames for large food product, textile, woodworking, and paper industries equipment manufactured in SIC's 3551-3554. This process is also used to fabricate pipes, tanks and the large pressure vessels used to pulp wood (SIC 3554).

Shears and press brakes were also listed by surveyed plants as fabrication equipment. Flame cutting operations were not encountered in these plants but are present in some plants in these two industries.

Plate or structural fabrication is a manufacturing process in 538 plants in SIC 355 and 26 plants in SIC 357 (see Table II-7). Percentages of use are approximately 15.0 and 2.3, respectively.


Metal Parts
Cutting and Forming
Welding
Fabricated Parts

NOTE: Negligible wastes are generated by these specific processes.

FIGURE III-9

SIMPLIFIED TYPICAL PLATE OR STRUCTURAL FABRICATION

The components of this waste stream are dependent upon the specific activities undertaken in a given operation. These wastes may include machining wastes and spent welding rods. It was found via the plant surveys that, negligible waste quantities are generated within these industries by this process.

Stamping, Blanking, and Forming

The term press work is used by the metals industry to embrace almost all press operations including stamping, blanking, forming, and related processes [35]. Blanking is a process accomplished with dies in presses in which desired shapes are cut from flat or preformed stock [38]. A blank is usually the workpiece for subsequent forming or machining, but may constitute a finished product in some cases.

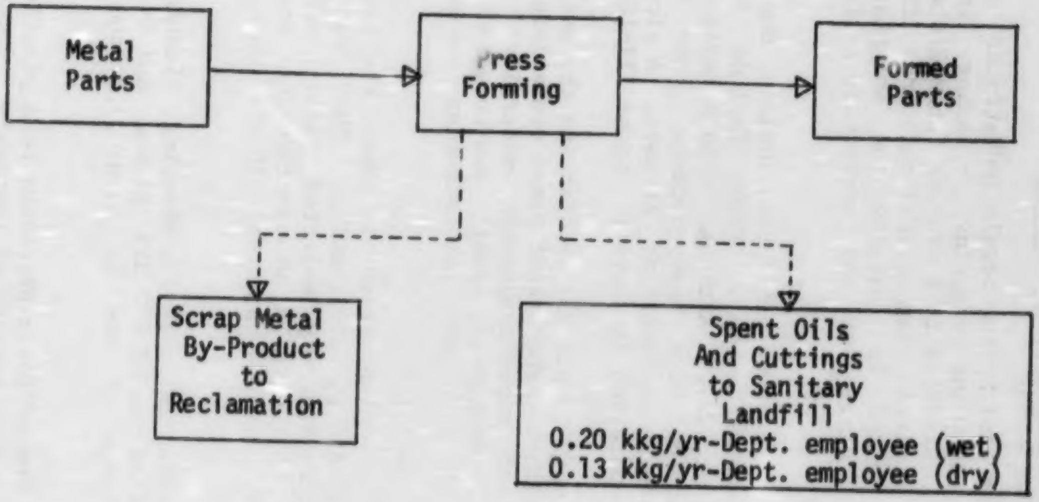
A number of processes are used in press forming, the choice depending on the type of shape needed. These include drawing, bending, stamping, and coining [29]. Although cold forming is most common, hot forming is used for very heavy stock. Some forming operations are dry and in others a lubricant is used. A simplified diagram of a press forming operation is shown in Figure III-10.

A major use for press work in SIC 357 is blanking the outline of printed circuit boards. Other products of press operations in the surveyed plants are tanks and pipe components, specialized machine parts, housings for large machinery, small sub-components, and transformer laminations. Some plants use stamping presses and shears.

Fifteen of the 33 surveyed plants reported that they engage in some type of stamping, blanking, or forming. They were almost equally divided between the randomly selected plants and those purposely picked for their potentially waste-producing processes. They were also about equally divided between SIC 355 and SIC 357 plants.

According to Census data (Table II-7), stamping, blanking, and forming of metals is practiced in 333 SIC 355 plants and in 117 SIC 357 plants. The percentage of use is about 9.3 and 10.3, respectively.

If the more exotic forms of these processes were practiced, the waste stream could contain a wide variety of chemicals. However, the plant surveys indicate that this is not the case in SIC 355 and 357 and this waste stream in these industries consists of metals (metallic drop-offs and clippings from punch presses, for example), and lubricants in some cases. The waste generation rate from this process is relatively low and has been estimated at 0.20 kkg/yr-dept.


Metal Parts
Press Forming
Formed Parts
Scrap Metal By-Product to Reclamation
Spent Oils And Cuttings to Sanitary Landfill
0.20 kkg/yr-Dept. employee (wet)
0.13 kkg/yr-Dept. employee (dry)

Note: This waste is considered potentially hazardous by the contractor.

FIGURE III-10

SIMPLIFIED TYPICAL FORMING OPERATION

employee on a wet basis and 0.13 kkg/yr-dept. employee on a dry basis. The process waste stream from stamping, blanking and forming is potentially hazardous due to its oil and toxic metals content, and has been combined with machine shop wastes in assessing quantities on a state, regional, and national basis.

Coating

The general term coating as used here includes the application of paint and other types of organic coatings (metals are not included). These include conventional solvent-thinned coatings such as lacquers and enamels, water-thinned paints, thermal- setting paint, Corvell (a coating that looks like porcelain but is actually a synthetic fiber), and other miscellaneous specialized products.

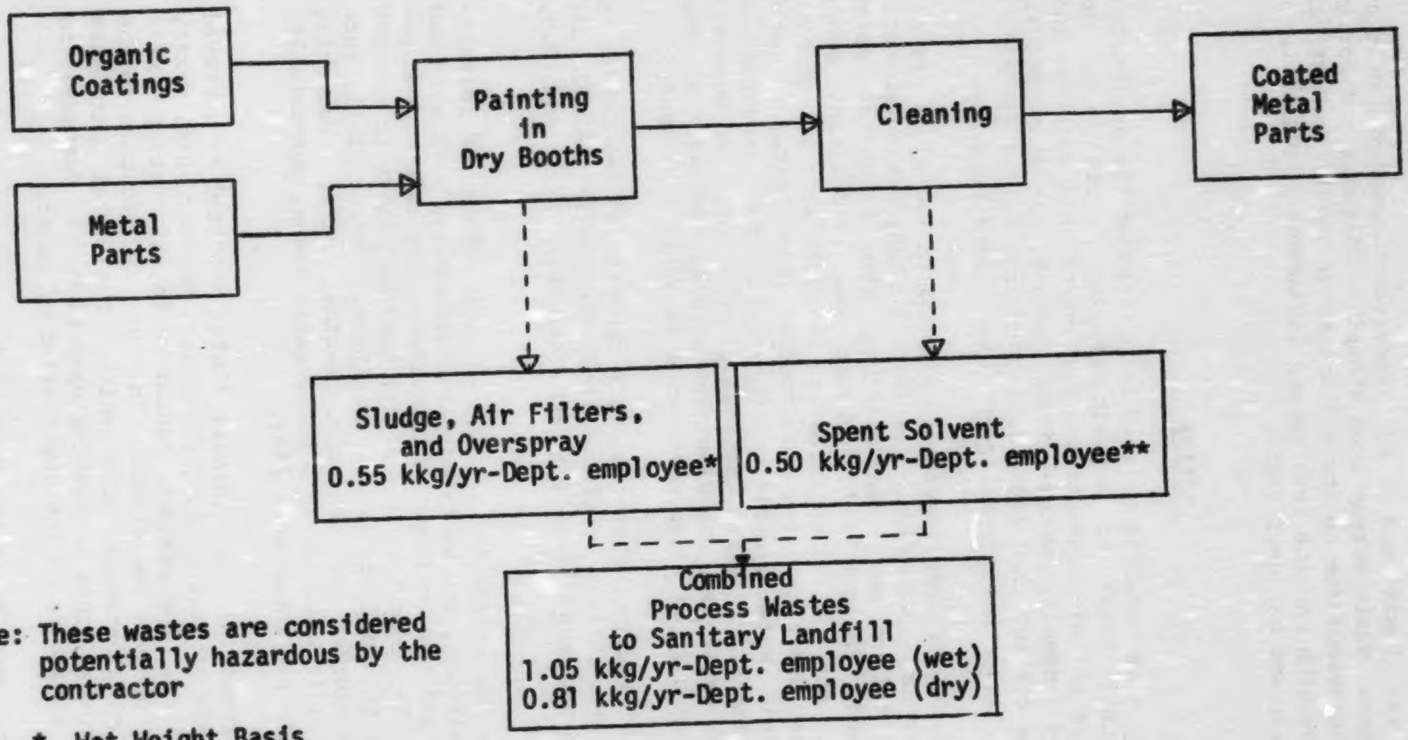
Several methods of application are employed including dry air filter spray booths, water-wash spray booths, electrostatic operations, and roller and dip coating, plus brush or spray application by hand. The air filter booth was predominant among surveyed plants, and is illustrated in Figure III-11. Eleven reported its use and nine water-wash booths were listed. Seven manual applications were reported and the other types appeared in only one or two plants. In a few instances, both dry- and wet-wall spray booths are employed. One plant operates two dry-wall priming booths, but the top coat on large components is applied by hand.

A total of 685 painting operations are reported by the Census in 3590 SIC 355 plants nationwide (Table II-7) and 102 in 1140 SIC 357 plants. The percentages of use are approximately 19.1 and 8.9, respectively.

The coating waste stream may consist of both water- and solvent-thinned paints, solvents, and wastewater sludges, along with acid and alkaline cleaners and the residue of materials they remove from the surface of metal. The constituents of the various paints in use may range over several thousand different substances. These fall into the general categories of pigments, resins, oils, solvents, plasticizers, and additives such as metal organic soaps, non-metallic driers, bactericides and fungicides [55].

The residues remaining in cleaning fluids reported by surveyed plants include metals utilized, oil, phosphate, chromic acid, waxes, inks, and carbon black. The residues contained in all coating wastes from these industries could conceivably include, in addition to the metal cleaned, any substances with which the metal part has previously been treated since a cleaning operation is designed to remove any surface hindrance to the application of paint.

The waste paint may be in the form of dry scrapings, spent air


Organic Coatings
Metal Parts
Painting in Dry Booths
Cleaning
Coated Metal Parts
Sludge, Air Filters, and Overspray 0.55 kkg/yr-Dept. employee*
Spent Solvent 0.50 kkg/yr-Dept. employee**
Combined Process Wastes to Sanitary Landfill 1.05 kkg/yr-Dept. employee (wet) 0.81 kkg/yr-Dept. employee (dry)

Note: These wastes are considered potentially hazardous by the contractor

* Wet Weight Basis
** Wet weight = Dry Weight

FIGURE III-11

SIMPLIFIED TYPICAL COATING OPERATION

(14 Employees)

filters, dust collector dusts, cleaning tank sludges, and sludges from wet-wall spray booths. The range of solvents used was discussed previously in this section.

Laboratory analysis of one grab sample of a paint sludge from an SIC 355 plant making food products machinery showed the following metal concentrations:

	Raw Sample ppm	Water Leachate ppm
Cd	1.5	<0.2
Cr	140	<0.2
Cu	45,300	<0.2
Fe	253,100	38
Pb	2,275	<2
Zn	7,608	1

The high chromium and zinc levels, 140 and 7608 ppm, respectively, in the raw sample are attributable to the use of a specific brand-name rust inhibitor which contains two to three percent zinc chromate ($ZnCrO4$). Chromium is the most common ingredient of rust inhibitors used in metal coatings, but the presence of zinc with the chromate is not equally frequent. This sample, of course, is only representative of the coatings, but the presence of zinc with chromate is not equally frequent. This sample, of course, is only representative of the coatings waste stream of this plant on one occasion and does not suggest the chromium and zinc levels of other painting wastes. This is illustrated by the following results on solvent from an SIC 3552 plant's painting operations:

	Raw Sample ppm	Water Leachate ppm
Cd	0.5	0.2
Cr	<0.1	<0.02
Cu	2.0	1.0
Fe	6.0	0.4
Pb	11.0	<1.0
Zn	2.0	1.0

The constituents of paint waste such as toxic and bioconcentrative materials cause paint wastes to be potentially hazardous.

The quantities of paint wastes are to a degree a function of the application method used. Spray application, by its very nature, has the greatest potential for loss and the waste quantity may range from 20 to 75 percent of the total coating applied, with the majority falling in the range of 40 to 60 percent [54]. As noted previously, this is by far the most common method used in the surveyed plants.

One plant in SIC 355, for example, uses 30 55-gal. drums of paint per year. It applies paint to miscellaneous machinery parts which by their size and shape are not likely to engender the largest percentage of less, nor the smallest. Thus, assuming a paint loss of approximately 40 percent, the plant generated about 660 gallons of waste paint per year. If a 60 percent paint loss is assumed, the quantity lost is about 990 gallons per year.

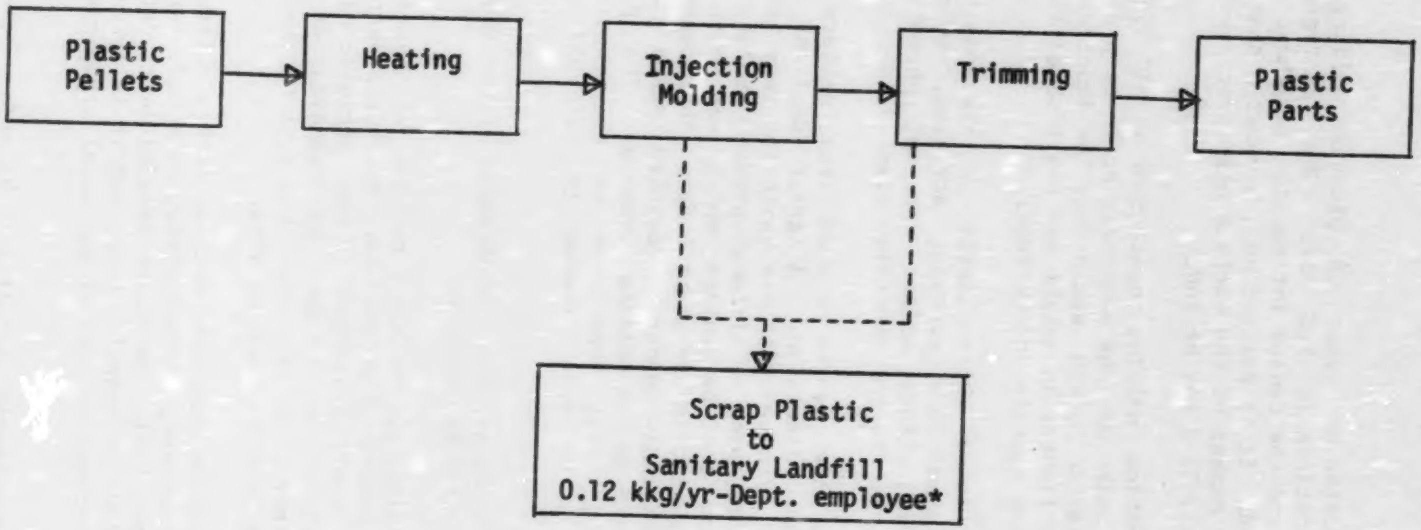
The efficiencies of wet electrostatic spray application processes ranged from 70 to better than 90 percent in an earlier study of factory-applied coatings [55]. Roller coatings operations generally have less than two percent paint losses. No estimates are available for losses from dip coatings. Manual painting with brush or commercial spray can result in negligible waste.

On the average, it is estimated, using the survey data, that the total process waste from coating operations is about 1.05 kkg/yr.-dept. employee on a wet basis, and 0.81 kkg/yr-dept. employee on a dry basis. This includes paint sludge, spent air filters, disposal (as opposed to reprocessing). At the present time, these wastes are sent to sanitary landfills in most cases.

Plastics Molding

Plastics molding operations, shown in Figure III-12, are employed in some surveyed plants to make small parts. These parts may be decorative in the case of calculators and adding machines, or they may be functional knobs, buttons, gears, and other sub-components. The most common process is injection molding, an operation in which plastic pellets are heated to plasticity and injected into the cavity of a controlled-temperature mold and hardened [29,39]. The edges on the shaped part are trimmed after ejection from the mold and it is then ready for use. One plant reported the additional use of transfer molding, a variation of injection molding [39]. Injection machines have the ability to use many thermosetting plastics as well as thermoplastic ones, although the transfer machine is limited to thermosetting materials.

Six surveyed plants have plastics molding operations. Of the six all but one are in use in SIC 357 plants making typewriters, computers or components, calculators and adding machines, and other office machines. The other is located in an SIC 3552 plant producing textile machinery. The latter operation is not shown in the Census


Plastic Pellets
Heating
Injection Molding
Trimming
Plastic Parts
Scrap Plastic to Sanitary Landfill 0.12 kkg/yr-Dept. employee*

NOTE: This waste is not considered potentially hazardous by the contractor.

*Wet Weight = Dry Weight

FIGURE III-12

SIMPLIFIED TYPICAL PLASTICS MOLDING OPERATION

(4 employees)

data in Table II-7 which indicates no usage of plastics molding in SIC 355 and only 31 such operations in SIC 357. The discrepancy between plant survey data and the Census information as shown in Table II-7 cannot be explained. It is pointed out, however, that in the contractor's opinion, the number of the various unit processes in SIC 355 and 357 quoted in Table II-7 may be low.

The slight usage of plastics molding operations in SIC 355 is due to the fact that the bulk of the machinery products of this industry are so large that plastic parts would not be functional. The SIC 357 products are much lighter in weight and their saleability is enhanced by the esthetics of plastic decorations.

Scrap plastic may be either thermoplastic or thermosetting polymers. Examples of the former are acetyls, acrylics, nylons, polystyrenes, and cellulosics; alkyds, aminos, epoxies, phenolics, polyesters, and others belong to the thermosetting class.

This is a solid waste which ranges in size from pellets to pieces several inches in dimension. A great deal of the thermoplastic type material is mixed with new resin and recycled — more than 50 percent in some cases — although product quality and color blends place limits on the percentage which can be reused successfully. The waste quantities are greater from thermosetting operations because these materials cannot be recycled since their chemical properties are changed in the molding process. The plant surveys indicate, however, that the use of the reuseable thermoplastic resins is much more common in SIC 357 than thermosetting.

Purge materials will contain varying percentages of two resins, one used to remove the other from the machine.

The scrap plastic discarded may retain a residue of hydraulic oil, the nature of which is described in the Raw Materials section, and/or mold-release agents. Small quantities of the hydraulic oil — on the order of pint or quart cans — may also be disposed of from time to time along with other plant wastes of this type or may be contained in floor sweepings from the molding area.

Mold-release agents include compounds such as waxes, silicones, fluoroplastics, metallic stearates, polyethylene, or a wide variety of proprietary chemical blends [56]. There are insufficient data on the losses of these materials to quantify them, but it is estimated that they amount to one percent or less of the total scrap plastic waste.

These wastes are not considered potentially hazardous based on the contractor's criteria as described earlier in this section.

The overall quantities of process waste from plastics molding operations are relatively small. On both a wet and dry basis, the generation rate is approximately 0.12 kkg/yr-Dept. employee. Based on an average process department size of four employees, which was found from the plant survey data, the total quantity of process waste generated is about 15 kkg/year (17 tons/yr) in SIC 357. Based on Census data as documented in Table II-7, a negligible amount of plastics molding waste is generated in SIC 355. This waste stream is not considered potentially hazardous by the contractor.

Assembly

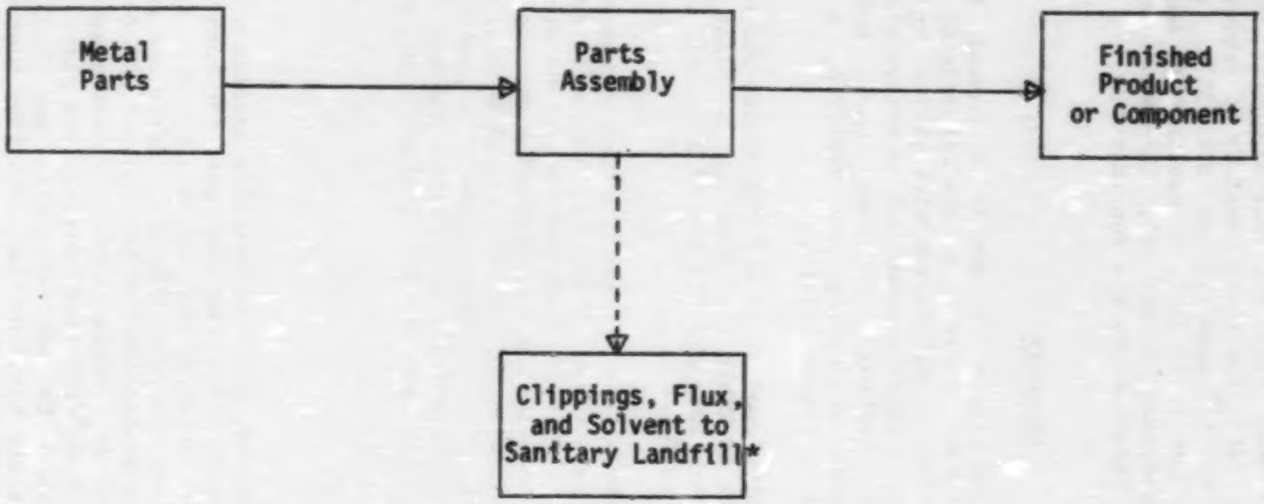
Assembly in the surveyed plants is mostly a manual floor or bench operation using small hand tools. A good example of this is the sub-assembly of printed circuit boards with wiring and other components, and the subsequent final assembly of an entire electronic calculator with attendant testing. In some cases, soldering, welding, adhesives, or solvent degreasing are employed. A typical assembly operation is shown in Figure III-13.

Assembly operations were found at 17 SIC 355 plants and nine SIC 357 facilities. Census data in Table II-7 show that no plants in SIC 355 reported assembly operations and 226 out of a total of 4730 plants in SIC 357 listed this function.

The assembly waste stream as it was reported by the surveyed plants includes wire cippings, solder dross, fluxes, oil, solvents, and spent welding rods. All of these have been addressed previously except solder dross. This consists of an insoluble mixture of lead and tin and, in many cases, antimony which is added to improve certain characteristics of the soldered joint. The quantities of these waste constituents are generally quite small and are combined with machining and fabricating wastes for disposal in sanitary landfills.

QUANTITIES OF WASTES

Quantities of total wastes, total potentially hazardous wastes, and total hazardous constituents have been estimated for both SIC 355 and 357 and are presented in Tables III-18, 19, and 20 for SIC 355, and Tables III-21, 22, and 23 for SIC 357. State and regional breakdowns of process waste generation for SIC 355 and 357 for 1975, 1977, and 1983 are presented in Tables III-24-29. Waste generation factors developed from 1975 data collected during the plant surveys inreach department were used to estimate 1977 and 1983 waste quantities. These estimates are based on the assumption that process technology as shown in Table II-7 in these industries will not change significantly by 1983. A linear extrapolation of production employee


Metal Parts
Parts Assembly
Finished Product or Component
Clippings, Flux, and Solvent to Sanitary Landfill*

*These wastes, present in relatively small quantities, are combined with machining and fabricating wastes.

FIGURE III-13

SIMPLIFIED ASSEMBLY OPERATION

TABLE III-18

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1975 National Totals
(kkg/year)

Process Waste	Total Waste[2]		Total Potentially Hazardous Waste[2]		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop [1]	79,000	50,900	79,000	50,900	18,440	3,052	1,202	--	--	27,535
Heat Treating	8,300	3,600	8,300	3,600	--	--	3,142	207	88	--
Electroplating	3,700	1,500	3,700	1,500	680	29	28	72	--	--
Coating	10,000	7,700	10,000	7,700	5,800	738	14	--	--	--
Ferrous and Nonferrous Foundry	173,000	173,000	--	--	--	--	--	--	--	--
TOTALS	274,000	236,700	101,000	63,700	24,920	3,819	4,386	279	88	27,535

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[1] Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

[2] The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE III-19

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1977 National Totals
(kkg/year)

Process Waste	Total Waste (2)		Total Potentially Hazardous Waste (2)		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	70,000	44,700	70,000	44,700	16,500	2,664	1,080	--	--	23,865
Heat Treating	8,300	3,600	8,300	3,600	--	--	3,142	207	88	--
Electroplating	3,700	1,500	3,700	1,500	680	29	28	72	--	--
Coating	9,000	6,700	9,000	6,700	4,853	729	14	--	--	--
Ferrous and Nonferrous Foundry	161,000	161,000	--	--	--	--	--	--	--	--
TOTALS	252,000	217,500	91,000	56,500	22,033	3,422	4,264	279	88	23,865

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(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractors estimates

TABLE III-20

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1983 National Totals
(kkg/year)

Process Waste	Total Waste(2)		Total Potentially Hazardous Waste(2)		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	84,000	64,000	77,000	57,000	13,864	2,305	3,970	--	2	20,194
Heat Treating	13,000	9,500	9,500	6,000	--	—	5,114	165	349	--
Electroplating	8,000	5,000	4,000	2,000	680	79	418	72	--	--
Coating	13,000	11,000	9,000	7,000	3,882	638	2,035	--	4	--
Ferrous and Nonferrous Foundry	123,000	123,000	--	--	--	--	--	--	--	--
TOTALS	241,000	212,500	99,500	72,000	18,426	3,022	11,537	237	355	20,194

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(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractors estimates

TABLE III-21

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1975 National Totals
(kkg/year)

Process Waste	Total Waste (2)		Total Potentially Hazardous Waste (2)		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	39,000	25,000	39,000	25,000	8,735	1,521	600	--	--	13,769
Heat Treating	6,200	2,500	6,200	2,500	--	--	2,114	165	58	--
Electroplating	22,000	8,400	22,000	8,400	3,882	172	170	228	--	--
Coating	3,500	2,600	3,500	2,600	1,941	274	5	--	--	--
Ferrous and Nonferrous Foundry	24,000	24,000	--	--	--	--	--	--	--	--
TOTALS	94,700	62,500	70,700	38,200	14,558	1,967	2,889	393	58	13,769

(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE III-22

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1977 National Totals
(kkg/year)

Process Waste	Total Waste[2]		Total Potentially Hazardous Waste[2]		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	39,000	25,000	39,000	25,000	8,735	1,521	600	--	--	13,769
Heat Treating	6,200	2,500	6,200	2,500	--	--	2,114	165	58	--
Electroplating	22,000	8,400	22,000	8,400	3,882	172	170	228	--	--
Coating	3,500	2,600	3,500	2,600	1,941	274	5	--	--	--
Ferrous and Nonferrous Foundry	22,000	22,000	--	--	--	--	--	--	--	--
TOTALS	92,700	60,500	70,700	38,500	14,558	1,967	2,889	393	58	13,769

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(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry weight factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE III-23

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1983 National Totals
(kkg/year)

Process Waste	Total Waste (2)		Total Potentially Hazardous Waste (2)		Total Hazardous Constituents (Dry Wt.)					
	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oil	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
Machine Shop (1)	87,000	73,000	73,000	59,000	8,735	1,661	7,003	--	4	13,769
Heat Treating	19,000	15,000	12,000	9,000	--	25	8,101	150	650	--
Electroplating	30,000	17,000	23,000	9,000	3,882	274	1,017	228	1	--
Coating	17,000	16,000	9,000	8,000	1,941	485	4,835	--	9	--
Ferrous and Nonferrous Foundry	17,000	17,000	--	--	--	--	--	--	--	--
Plastics Molding			--	--	--	--	--	--	--	--
TOTALS	153,000	138,000	117,000	85,000	14,558	2,445	20,956	378	664	13,769

(1) Includes Tool & Die Shop; Stamping, Blanking, and Forming; and Plate & Structural Fabrication

(2) The wet and dry factors used in deriving these waste totals are approximate and will vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

TABLE III-24

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	2588.	2235.	954.	602.	235.	36.1	41.4	2.6	.8	260.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	730.	630.	269.	170.	66.	10.2	11.7	.7	.2	73.
ARKANSAS	VI	689.	596.	254.	160.	63.	9.6	11.0	.7	.2	69.
CALIFORNIA	IX	16449.	14210.	6063.	3824.	1496.	229.3	263.3	16.8	5.3	1653.
COLORADO	VIII	349.	302.	129.	81.	32.	4.9	5.6	.4	.1	35.
CONNECTICUT	I	7790.	6730.	2872.	1811.	709.	108.6	124.7	8.0	2.5	783.
DELAWARE	III	1211.	1046.	446.	282.	110.	16.9	19.4	1.2	.4	122.
FLORIDA	IV	4222.	3647.	1556.	982.	384.	58.8	67.6	4.3	1.4	424.
GEORGIA	IV	4916.	4247.	1812.	1143.	447.	68.5	78.7	5.0	1.6	494.
HAWAII	IX	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	21846.	18872.	8053.	5079.	1987.	304.5	349.7	22.3	7.0	2195.
INDIANA	V	8119.	7014.	2993.	1888.	738.	113.2	130.0	8.3	2.6	816.
IOWA	VII	3237.	2796.	1193.	753.	294.	45.1	51.8	3.3	1.0	325.
KANSAS	VII	2386.	2061.	880.	555.	217.	33.3	38.2	2.4	.8	240.
KENTUCKY	IV	1876.	1621.	691.	436.	171.	26.1	30.0	1.9	.6	189.
LOUISIANA	VI	1280.	1106.	472.	298.	116.	17.8	20.5	1.3	.4	129.
MAINE	I	963.	832.	355.	224.	88.	13.4	15.4	1.0	.3	97.
MARYLAND	III	4473.	3864.	1649.	1040.	407.	62.3	71.6	4.6	1.4	449.
MASSACHUSETTS	I	23870.	20620.	8799.	5549.	2171.	332.7	382.1	24.4	7.7	2399.
MICHIGAN	V	8907.	7695.	3283.	2071.	810.	124.1	142.6	9.1	2.9	895.
MINNESOTA	V	2384.	2060.	879.	554.	217.	33.2	38.2	2.4	.8	240.
MISSISSIPPI	IV	1289.	1114.	475.	300.	117.	18.0	20.6	1.3	.4	130.
MISSOURI	VII	1791.	1547.	660.	416.	163.	25.0	28.7	1.8	.6	180.
MONTANA	VIII	107.	93.	40.	25.	10.	1.5	1.7	.1	.0	11.
NEBRASKA	VII	289.	249.	106.	67.	26.	4.0	4.6	.3	.1	29.
NEVADA	IX	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
NEW HAMPSHIRE	I	2080.	1797.	767.	483.	189.	29.0	33.3	2.1	.7	209.
NEW JERSEY	II	16341.	14117.	6024.	3799.	1486.	227.8	261.6	16.7	5.2	1642.
NEW MEXICO	VI	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
NEW YORK	II	15755.	13610.	5807.	3663.	1433.	219.6	252.2	16.1	5.1	1583.
NORTH CAROLINA	IV	15598.	13475.	5750.	3626.	1419.	217.4	249.7	15.9	5.0	1568.
NORTH DAKOTA	VIII	190.	164.	70.	44.	17.	2.7	3.0	.2	.1	19.
OHIO	V	27351.	23627.	10082.	6358.	2488.	381.2	437.8	27.9	8.8	2749.
OKLAHOMA	VI	2415.	2087.	890.	562.	220.	33.7	38.7	2.5	.8	243.
OREGON	X	3018.	2607.	1112.	702.	274.	42.1	48.3	3.1	1.0	303.
PENNSYLVANIA	III	21996.	19002.	8108.	5114.	2001.	306.6	352.1	22.5	7.1	2210.
RHODE ISLAND	I	5623.	4858.	2073.	1307.	511.	78.4	90.0	5.7	1.8	565.
SOUTH CAROLINA	IV	11423.	9868.	4211.	2656.	1039.	159.2	182.9	11.7	3.7	1148.
SOUTH DAKOTA	VIII	190.	164.	70.	44.	17.	2.7	3.0	.2	.1	19.
TENNESSEE	IV	3597.	3108.	1326.	836.	327.	50.1	57.6	3.7	1.2	362.
TEXAS	VI	5113.	4417.	1885.	1189.	465.	71.3	81.8	5.2	1.6	514.
UTAH	VIII	110.	95.	40.	26.	10.	1.5	1.8	.1	.0	11.
VERMONT	I	1216.	1050.	448.	283.	111.	16.9	19.5	1.2	.4	122.
VIRGINIA	III	2297.	1984.	847.	534.	209.	32.0	36.8	2.3	.7	231.
WASHINGTON	X	4844.	4185.	1786.	1126.	441.	67.5	77.5	5.0	1.6	487.
WEST VIRGINIA	III	611.	528.	225.	142.	56.	8.5	9.8	.6	.2	61.
WISCONSIN	V	11820.	10211.	4357.	2748.	1075.	164.7	189.2	12.1	3.8	1188.
WYOMING	VIII	334.	288.	123.	78.	30.	4.6	5.3	.3	.1	34.
TOTALS		274000.	236700.	101000.	63700.	24920.	3819.0	4386.0	280.0	88.0	27535.
REGION I		41541.	35886.	15312.	9657.	3778.	579.0	665.0	42.5	13.3	4175.
II		32096.	27727.	11831.	7462.	2919.	447.4	513.8	32.8	10.3	3225.
III		30587.	26424.	11275.	7111.	2782.	426.3	489.6	31.3	9.8	3074.
IV		45510.	39314.	16775.	10580.	4139.	634.3	728.5	46.5	14.6	4573.
V		80415.	69468.	29642.	18695.	7314.	1120.8	1287.2	82.2	25.8	8081.
VI		9648.	8335.	3556.	2243.	877.	134.5	154.4	9.9	3.1	970.
VII		7714.	6664.	2843.	1793.	702.	107.5	123.5	7.9	2.5	775.
VIII		1269.	1096.	468.	295.	115.	17.7	20.3	1.3	.4	128.
IX		17358.	14995.	6398.	4035.	1579.	241.9	277.8	17.7	5.6	1744.
X		7862.	6792.	2898.	1828.	715.	109.6	125.8	8.0	2.5	790.

TABLE III-25

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.) Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	2380.	2054.	859.	534.	208.	32.3	40.3	2.6	.8	225.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	671.	579.	242.	150.	59.	9.1	11.4	.7	.2	64.
ARKANSAS	VI	634.	547.	229.	142.	55.	8.6	10.7	.7	.2	60.
CALIFORNIA	IX	15128.	13057.	5463.	3392.	1323.	205.4	256.0	16.8	5.3	1433.
COLORADO	VIII	321.	277.	116.	72.	28.	4.4	5.4	.4	.1	30.
CONNECTICUT	I	7165.	6184.	2587.	1606.	626.	97.3	121.2	8.0	2.5	679.
DELAWARE	III	1114.	961.	402.	250.	97.	15.1	18.8	1.2	.4	105.
FLORIDA	IV	3883.	3351.	1402.	871.	339.	52.7	65.7	4.3	1.4	368.
GEORGIA	IV	4521.	3902.	1633.	1014.	395.	61.4	76.5	5.0	1.6	428.
HAWAII	IX	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	20092.	17341.	7255.	4505.	1757.	272.8	340.0	22.3	7.0	1903.
INDIANA	V	7467.	6445.	2697.	1674.	653.	101.4	126.4	8.3	2.6	707.
IOWA	VII	2977.	2569.	1075.	667.	260.	40.4	50.4	3.3	1.0	282.
KANSAS	VII	2195.	1894.	793.	492.	192.	29.8	37.1	2.4	.8	208.
KENTUCKY	IV	1725.	1489.	623.	387.	151.	23.4	29.2	1.9	.6	163.
LOUISIANA	VI	1178.	1016.	425.	264.	103.	16.0	19.9	1.3	.4	112.
MAINE	I	885.	764.	320.	198.	77.	12.0	15.0	1.0	.3	84.
MARYLAND	III	4113.	3550.	1485.	922.	360.	55.9	69.6	4.6	1.4	390.
MASSACHUSETTS	I	21953.	18948.	7927.	4922.	1919.	298.1	371.5	24.4	7.7	2079.
MICHIGAN	V	8192.	7070.	2958.	1837.	716.	111.2	138.5	9.1	2.9	776.
MINNESOTA	V	2193.	1892.	792.	492.	192.	29.8	37.1	2.4	.8	208.
MISSISSIPPI	IV	1186.	1024.	428.	266.	104.	16.1	20.1	1.3	.4	112.
MISSOURI	VII	1647.	1422.	595.	369.	144.	22.4	27.9	1.8	.6	156.
MONTANA	VIII	99.	85.	36.	22.	9.	1.3	1.7	.1	.0	9.
NEBRASKA	VII	266.	229.	96.	60.	23.	3.6	4.5	.3	.1	25.
NEVADA	IX	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
NEW HAMPSHIRE	I	1913.	1651.	691.	429.	167.	26.0	32.4	2.1	.7	181.
NEW JERSEY	II	15029.	12972.	5427.	3370.	1314.	204.1	254.3	16.7	5.2	1423.
NEW MEXICO	VI	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
NEW YORK	II	14490.	12506.	5232.	3249.	1267.	196.8	245.2	16.1	5.1	1372.
NORTH CAROLINA	IV	14346.	12382.	5180.	3216.	1254.	194.8	242.7	15.9	5.0	1359.
NORTH DAKOTA	VIII	175.	151.	63.	39.	15.	2.4	3.0	.2	.1	17.
OHIO	V	25155.	21711.	9084.	5640.	2199.	341.6	425.6	27.9	8.8	2382.
OKLAHOMA	VI	2221.	1917.	802.	498.	194.	30.2	37.6	2.5	.8	210.
OREGON	X	2775.	2395.	1002.	622.	243.	37.7	47.0	3.1	1.0	263.
PENNSYLVANIA	III	20230.	17460.	7305.	4536.	1769.	274.7	342.3	22.5	7.1	1916.
RHODE ISLAND	I	5172.	4464.	1868.	1160.	452.	70.2	87.5	5.7	1.8	490.
SOUTH CAROLINA	IV	10506.	9068.	3794.	2356.	919.	142.7	177.8	11.7	3.7	995.
SOUTH DAKOTA	VIII	175.	151.	63.	39.	15.	2.4	3.0	.2	.1	17.
TENNESSEE	IV	3309.	2856.	1195.	742.	289.	44.9	56.0	3.7	1.2	313.
TEXAS	VI	4702.	4059.	1698.	1054.	411.	63.9	79.6	5.2	1.6	445.
UTAH	VIII	101.	87.	36.	23.	9.	1.4	1.7	.1	.0	10.
VERMONT	I	1118.	965.	404.	251.	98.	15.2	18.9	1.2	.4	106.
VIRGINIA	III	2112.	1823.	763.	474.	185.	28.7	35.7	2.3	.7	200.
WASHINGTON	X	4455.	3845.	1609.	999.	390.	60.5	75.4	5.0	1.6	422.
WEST VIRGINIA	III	562.	485.	203.	126.	49.	7.6	9.5	.6	.2	53.
WISCONSIN	V	10870.	9382.	3925.	2437.	950.	147.6	183.9	12.1	3.8	1029.
WYOMING	VIII	307.	265.	111.	69.	27.	4.2	5.2	.3	.1	29.
TOTALS		252000.	217500.	91000.	56500.	22033.	3422.0	4264.0	280.0	88.0	23865.
REGION I		38205.	32975.	13796.	8566.	3340.	518.8	646.5	42.5	13.3	3618.
II		29519.	25478.	10660.	6618.	2581.	400.9	499.5	32.8	10.3	2796.
III		28132.	24280.	10159.	6307.	2460.	382.0	476.0	31.3	9.8	2664.
IV		41856.	36125.	15115.	9384.	3660.	568.4	708.2	46.5	14.6	3964.
V		73959.	63833.	26707.	16582.	6466.	1004.3	1251.4	82.2	25.8	7004.
VI		8873.	7659.	3204.	1989.	776.	120.5	150.1	9.9	3.1	840.
VII		7095.	6123.	2562.	1591.	620.	96.3	120.0	7.9	2.5	672.
VIII		1167.	1008.	422.	262.	102.	15.9	19.8	1.3	.4	111.
IX		15964.	13778.	5765.	3579.	1396.	216.8	270.1	17.7	5.6	1512.
X		7231.	6241.	2611.	1621.	632.	98.2	122.3	8.0	2.5	685.

TABLE III-26

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION
1983 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	2276.	2007.	940.	680.	174.	28.5	109.0	2.2	3.4	191.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	642.	566.	265.	192.	49.	8.0	30.7	.6	.9	54.
ARKANSAS	VI	606.	535.	250.	181.	46.	7.6	29.0	.6	.9	51.
CALIFORNIA	IX	14468.	12757.	5973.	4322.	1106.	181.4	692.6	14.2	21.3	1212.
COLORADO	VIII	307.	271.	127.	92.	23.	3.9	14.7	.3	.5	26.
CONNECTICUT	I	6852.	6042.	2829.	2047.	524.	85.9	328.0	6.7	10.1	574.
DELAWARE	III	1065.	939.	440.	318.	81.	13.4	51.0	1.0	1.6	89.
FLORIDA	IV	3713.	3274.	1533.	1109.	284.	46.6	177.8	3.7	5.5	311.
GEORGIA	IV	4324.	3812.	1785.	1292.	331.	54.2	207.0	4.3	6.4	362.
HAWAII	IX	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	19215.	16943.	7933.	5741.	1469.	240.9	919.8	18.9	28.3	1610.
INDIANA	V	7141.	6297.	2948.	2134.	546.	89.5	341.9	7.0	10.5	598.
IOWA	VII	2847.	2510.	1175.	851.	218.	35.7	136.3	2.8	4.2	239.
KANSAS	VII	2099.	1851.	867.	627.	160.	26.3	100.5	2.1	3.1	176.
KENTUCKY	IV	1650.	1455.	681.	493.	126.	20.7	79.0	1.6	2.4	138.
LOUISIANA	VI	1126.	993.	465.	336.	86.	14.1	53.9	1.1	1.7	94.
MAINE	I	847.	747.	350.	253.	65.	10.6	40.5	.8	1.2	71.
MARYLAND	III	3934.	3469.	1624.	1175.	301.	49.3	188.3	3.9	5.8	330.
MASSACHUSETTS	I	20995.	18512.	8668.	6272.	1605.	263.3	1005.0	20.6	30.9	1759.
MICHIGAN	V	7834.	6908.	3235.	2341.	599.	98.2	375.0	7.7	11.5	656.
MINNESOTA	V	2097.	1849.	866.	626.	160.	26.3	100.4	2.1	3.1	176.
MISSISSIPPI	IV	1134.	1000.	468.	339.	87.	14.2	54.3	1.1	1.7	95.
MISSOURI	VII	1575.	1389.	650.	471.	120.	19.8	75.4	1.5	2.3	132.
MONTANA	VIII	95.	83.	39.	28.	7.	1.2	4.5	.1	.1	8.
NEBRASKA	VII	254.	224.	105.	76.	19.	3.2	12.2	.2	.4	21.
NEVADA	IX	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
NEW HAMPSHIRE	I	1829.	1613.	755.	546.	140.	22.9	87.6	1.8	2.7	153.
NEW JERSEY	II	14373.	12674.	5934.	4294.	1099.	180.2	688.1	14.1	21.2	1204.
NEW MEXICO	VI	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
NEW YORK	II	13857.	12219.	5721.	4140.	1059.	173.8	663.4	13.6	20.4	1161.
NORTH CAROLINA	IV	13720.	12097.	5664.	4099.	1049.	172.0	656.8	13.5	20.2	1150.
NORTH DAKOTA	VIII	167.	148.	69.	50.	13.	2.1	8.0	.2	.2	14.
OHIO	V	24056.	21212.	9932.	7187.	1839.	301.7	1151.6	23.7	35.4	2016.
OKLAHOMA	VI	2124.	1873.	877.	635.	162.	26.6	101.7	2.1	3.1	178.
OREGON	X	2654.	2340.	1096.	793.	203.	33.3	127.1	2.6	3.9	222.
PENNSYLVANIA	III	19347.	17059.	7988.	5780.	1479.	242.6	926.2	19.0	28.5	1621.
RHODE ISLAND	I	4946.	4361.	2042.	1478.	378.	62.0	236.8	4.9	7.3	414.
SOUTH CAROLINA	IV	10047.	8859.	4148.	3002.	768.	126.0	481.0	9.9	14.8	842.
SOUTH DAKOTA	VIII	167.	148.	69.	50.	13.	2.1	8.0	.2	.2	14.
TENNESSEE	IV	3164.	2790.	1306.	945.	242.	39.7	151.5	3.1	4.7	265.
TEXAS	VI	4497.	3965.	1857.	1344.	344.	56.4	215.3	4.4	6.6	377.
UTAH	VIII	96.	85.	40.	29.	7.	1.2	4.6	.1	.1	8.
VERMONT	I	1069.	943.	441.	319.	82.	13.4	51.2	1.1	1.6	90.
VIRGINIA	III	2020.	1781.	834.	604.	154.	25.3	96.7	2.0	3.0	169.
WASHINGTON	X	4261.	3757.	1759.	1273.	326.	53.4	204.0	4.2	6.3	357.
WEST VIRGINIA	III	538.	474.	222.	161.	41.	6.7	25.7	.5	.8	45.
WISCONSIN	V	10396.	9167.	4292.	3106.	795.	130.4	497.7	10.2	15.3	871.
WYOMING	VIII	293.	259.	121.	88.	22.	3.7	14.0	.3	.4	25.
TOTALS		241000.	212500.	99500.	72000.	18426.	3022.0	11537.0	237.0	355.0	20194.
REGION I		36538.	32217.	15085.	10916.	2794.	458.2	1749.1	35.9	53.8	3062.
II		28231.	24892.	11655.	8434.	2158.	354.0	1351.4	27.8	41.6	2366.
III		26904.	23722.	11107.	8038.	2057.	337.4	1287.9	26.5	39.6	2254.
IV		40029.	35295.	16526.	11959.	3060.	501.9	1916.2	39.4	59.0	3354.
V		70730.	62366.	29202.	21131.	5408.	886.9	3385.9	69.6	104.2	5927.
VI		8486.	7483.	3504.	2535.	649.	106.4	406.2	8.3	12.5	711.
VII		6785.	5983.	2801.	2027.	519.	85.1	324.8	6.7	10.0	569.
VIII		1116.	984.	461.	334.	85.	14.0	53.4	1.1	1.6	94.
IX		15267.	13462.	6303.	4561.	1167.	191.4	730.9	15.0	22.5	1279.
X		6915.	6097.	2855.	2066.	529.	86.7	331.0	6.8	10.2	579.

TABLE III-27

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.): Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	78.	52.	58.	32.	12.	1.6	2.4	.3	.0	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	772.	509.	576.	311.	119.	16.0	23.5	3.2	.5	112.
ARKANSAS	VI	2630.	1736.	1964.	1061.	404.	54.6	80.1	10.9	1.6	382.
CALIFORNIA	IX	16484.	10879.	12306.	6649.	2534.	342.4	502.0	68.4	10.1	2397.
COLORADO	VIII	4087.	2697.	3051.	1648.	628.	84.9	124.5	17.0	2.5	594.
CONNECTICUT	I	3864.	2550.	2885.	1559.	594.	80.3	117.7	16.0	2.4	562.
DELAWARE	III	1491.	984.	1113.	602.	229.	31.0	45.4	6.2	.9	217.
FLORIDA	IV	1851.	1221.	1382.	746.	284.	38.4	56.4	7.7	1.1	269.
GEORGIA	IV	142.	94.	106.	57.	22.	3.0	4.3	.6	.1	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	3949.	2606.	2948.	1593.	607.	82.0	120.3	16.4	2.4	574.
INDIANA	V	1950.	1287.	1456.	787.	300.	40.5	59.4	8.1	1.2	284.
IOWA	VII	102.	67.	76.	41.	16.	2.1	3.1	.4	.1	15.
KANSAS	VII	869.	573.	649.	350.	134.	18.0	26.5	3.6	.5	126.
KENTUCKY	IV	3679.	2428.	2746.	1484.	566.	76.4	112.0	15.3	2.3	535.
LOUISIANA	VI	38.	25.	29.	15.	6.	.8	1.2	.2	.0	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	584.	386.	436.	236.	90.	12.1	17.8	2.4	.4	85.
MASSACHUSETTS	I	7724.	5098.	5767.	3116.	1187.	160.4	235.2	32.1	4.7	1123.
MICHIGAN	V	1669.	1102.	1246.	673.	257.	34.7	50.8	6.9	1.0	243.
MINNESOTA	V	7086.	4677.	5291.	2859.	1089.	147.2	215.8	29.4	4.3	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	197.	130.	147.	79.	30.	4.1	6.0	.8	.1	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	158.	104.	118.	64.	24.	3.3	4.8	.7	.1	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	737.	486.	550.	297.	113.	15.3	22.4	3.1	.5	107.
NEW JERSEY	II	3101.	2047.	2315.	1251.	477.	64.4	94.5	12.9	1.9	451.
NEW MEXICO	VI	515.	340.	384.	208.	79.	10.7	15.7	2.1	.3	75.
NEW YORK	II	12443.	8212.	9290.	5019.	1913.	258.5	378.9	51.6	7.6	1809.
NORTH CAROLINA	IV	1755.	1158.	1310.	708.	270.	36.5	53.5	7.3	1.1	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	2960.	1953.	2210.	1194.	455.	61.5	90.1	12.3	1.8	430.
OKLAHOMA	VI	1549.	1023.	1157.	625.	238.	32.2	47.2	6.4	.9	225.
OREGON	X	415.	274.	310.	167.	64.	8.6	12.6	1.7	.3	60.
PENNSYLVANIA	III	1790.	1181.	1336.	722.	275.	37.2	54.5	7.4	1.1	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	623.	411.	465.	251.	96.	12.9	19.0	2.6	.4	91.
SOUTH DAKOTA	VIII	303.	200.	226.	122.	47.	6.3	9.2	1.3	.2	44.
TENNESSEE	IV	458.	302.	342.	185.	70.	9.5	14.0	1.9	.3	67.
TEXAS	VI	4720.	3115.	3524.	1904.	726.	98.0	143.8	19.6	2.9	686.
UTAH	VIII	684.	451.	511.	276.	105.	14.2	20.8	2.8	.4	99.
VERMONT	I	174.	115.	130.	70.	27.	3.6	5.3	.7	.1	25.
VIRGINIA	III	289.	191.	216.	117.	44.	6.0	8.8	1.2	.2	42.
WASHINGTON	X	1959.	1293.	1463.	790.	301.	40.7	59.7	8.1	1.2	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	527.	348.	393.	213.	81.	10.9	16.0	2.2	.3	77.
WYOMING	VIII	293.	194.	219.	118.	45.	6.1	8.9	1.2	.2	43.
TOTALS		94700.	62500.	70700.	38200.	14558.	1967.0	2884.0	393.0	58.0	13769.
REGION I		12538.	8275.	9360.	5057.	1927.	260.4	381.8	52.0	7.7	1823.
II		15544.	10259.	11605.	6270.	2390.	322.9	473.4	64.5	9.5	2260.
III		4154.	2742.	3101.	1676.	639.	86.3	126.5	17.2	2.5	604.
IV		8586.	5667.	6410.	3464.	1320.	178.3	261.5	35.6	5.3	1248.
V		18141.	11973.	13544.	7318.	2789.	376.8	552.5	75.3	11.1	2638.
VI		7556.	4987.	5641.	3048.	1162.	156.9	230.1	31.4	4.6	1099.
VII		1325.	875.	990.	535.	204.	27.5	40.4	5.5	.8	193.
VIII		5782.	3816.	4617.	2332.	889.	120.1	176.1	24.0	3.5	841.
IX		19114.	12615.	14270.	7710.	2938.	397.0	582.1	79.3	11.7	2779.
X		1959.	1293.	1463.	790.	301.	40.7	59.7	8.1	1.2	285.

TABLE III-28

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	76.	50.	58.	32.	12.	1.6	2.4	.3	.0	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	755.	493.	576.	314.	119.	16.0	23.5	3.2	.5	112.
ARKANSAS	VI	2575.	1680.	1964.	1069.	404.	54.6	80.2	10.9	1.6	382.
CALIFORNIA	IX	16135.	10531.	12306.	6701.	2534.	342.4	502.9	68.4	10.1	2397.
COLORADO	VIII	4000.	2611.	3051.	1661.	628.	84.9	124.7	17.0	2.5	594.
CONNECTICUT	I	3783.	2469.	2885.	1571.	594.	80.3	117.9	16.0	2.4	562.
DELAWARE	III	1460.	953.	1113.	606.	229.	31.0	45.5	6.2	.9	217.
FLORIDA	IV	1812.	1182.	1382.	752.	284.	38.4	56.5	7.7	1.1	269.
GEORGIA	IV	139.	91.	106.	58.	22.	3.0	4.3	.6	.1	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	3865.	2523.	2948.	1605.	607.	82.0	120.5	16.4	2.4	574.
INDIANA	V	1909.	1246.	1456.	793.	300.	40.5	59.5	8.1	1.2	284.
IOWA	VII	99.	65.	76.	41.	16.	2.1	3.1	.4	.1	15.
KANSAS	VII	851.	555.	649.	353.	134.	18.0	26.5	3.6	.5	126.
KENTUCKY	IV	3601.	2350.	2746.	1496.	566.	76.4	112.2	15.3	2.3	535.
LOUISIANA	VI	37.	24.	29.	16.	6.	.8	1.2	.2	.0	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	572.	373.	436.	237.	90.	12.1	17.8	2.4	.4	85.
MASSACHUSETTS	I	7561.	4935.	5767.	3140.	1187.	160.4	235.6	32.1	4.7	1123.
MICHIGAN	V	1634.	1066.	1246.	679.	257.	34.7	50.9	6.9	1.0	243.
MINNESOTA	V	6937.	4527.	5291.	2881.	1089.	147.2	216.2	29.4	4.3	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	193.	126.	147.	80.	30.	4.1	6.0	.8	.1	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	155.	101.	118.	64.	24.	3.3	4.8	.7	.1	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	721.	471.	550.	300.	113.	15.3	22.5	3.1	.5	107.
NEW JERSEY	II	3036.	1981.	2315.	1261.	477.	64.4	94.6	12.9	1.9	451.
NEW MEXICO	VI	504.	329.	384.	209.	79.	10.7	15.7	2.1	.3	75.
NEW YORK	II	12180.	7949.	9290.	5059.	1913.	258.5	379.6	51.6	7.6	1809.
NORTH CAROLINA	IV	1718.	1121.	1310.	714.	270.	36.5	53.5	7.3	1.1	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	2897.	1891.	2210.	1203.	455.	61.5	90.3	12.3	1.8	430.
OKLAHOMA	VI	1517.	990.	1157.	630.	238.	32.2	47.3	6.4	.9	225.
OREGON	X	406.	265.	310.	169.	64.	8.6	12.7	1.7	.3	60.
PENNSYLVANIA	III	1752.	1143.	1336.	728.	275.	37.2	54.6	7.4	1.1	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	610.	398.	465.	253.	96.	12.9	19.0	2.6	.4	91.
SOUTH DAKOTA	VIII	297.	194.	226.	123.	47.	6.3	9.2	1.3	.2	44.
TENNESSEE	IV	449.	293.	342.	186.	70.	9.5	14.0	1.9	.3	67.
TEXAS	VI	4621.	3016.	3524.	1919.	726.	98.0	144.0	19.6	2.9	686.
UTAH	VIII	670.	437.	511.	278.	105.	14.2	20.9	2.8	.4	99.
VERMONT	I	170.	111.	130.	71.	27.	3.6	5.3	.7	.1	25.
VIRGINIA	III	283.	185.	216.	118.	44.	6.0	8.8	1.2	.2	42.
WASHINGTON	X	1918.	1252.	1463.	796.	301.	40.7	59.8	8.1	1.2	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	516.	337.	393.	214.	81.	10.9	16.1	2.2	.3	77.
WYOMING	VIII	287.	187.	219.	119.	45.	6.1	9.0	1.2	.2	43.
TOTALS		92700.	60500.	70700.	38500.	14558.	1967.0	2889.0	393.0	58.0	13769.
REGION I		12273.	8010.	9360.	5097.	1927.	260.4	382.5	52.0	7.7	1823.
II		15216.	9931.	11605.	6320.	2390.	322.9	474.2	64.5	9.5	2260.
III		4067.	2654.	3101.	1689.	639.	86.3	126.7	17.2	2.5	604.
IV		8405.	5485.	6410.	3491.	1320.	178.3	261.9	35.6	5.3	1248.
V		17758.	11590.	13544.	7375.	2789.	376.8	553.4	75.3	11.1	2638.
VI		7396.	4827.	5641.	3072.	1162.	156.9	230.5	31.4	4.6	1099.
VII		1297.	847.	990.	539.	204.	27.5	40.4	5.5	.8	193.
VIII		5660.	3694.	4317.	2351.	889.	120.1	176.4	24.0	3.5	841.
IX		18710.	12211.	14270.	7771.	2938.	397.0	583.1	79.3	11.7	2779.
X		1918.	1252.	1463.	796.	301.	40.7	59.8	8.1	1.2	285.

TABLE III-29

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION
1983 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	**EPA Region**	**(Wet Wt.)**	**(Dry Wt.)**	**(Wet Wt.)**	**(Dry Wt.)**	**Flammable Solvents**	**Heavy Metals**	**Oils**	**Acids/Alkali Solution**	**Cyanide**	**Sweepings & Grindings**
ALABAMA	IV	126.	114.	97.	70.	12.	2.0	17.3	.3	.5	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	1247.	1124.	953.	693.	119.	19.9	170.8	3.1	5.4	112.
ARKANSAS	VI	4249.	3833.	3249.	2361.	404.	67.9	582.0	10.5	18.4	382.
CALIFORNIA	IX	26631.	24020.	20365.	14795.	2534.	425.6	3647.6	65.8	115.6	2397.
COLORADO	VIII	6602.	5955.	5049.	3668.	628.	105.5	904.3	16.3	28.7	594.
CONNECTICUT	I	6243.	5631.	4774.	3469.	594.	99.8	855.1	15.4	27.1	562.
DELAWARE	III	2409.	2173.	1842.	1338.	229.	38.5	330.0	6.0	10.5	217.
FLORIDA	IV	2990.	2697.	2286.	1661.	284.	47.8	409.5	7.4	13.0	269.
GEORGIA	IV	230.	207.	176.	128.	22.	3.7	31.5	.6	1.0	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	6379.	5754.	4878.	3544.	607.	101.9	873.8	15.8	27.7	574.
INDIANA	V	3151.	2842.	2410.	1751.	300.	50.4	431.6	7.8	13.7	284.
IOWA	VII	164.	148.	125.	91.	16.	2.6	22.5	.4	.7	15.
KANSAS	VII	1404.	1266.	1073.	780.	134.	22.4	192.3	3.5	6.1	126.
KENTUCKY	IV	5943.	5361.	4545.	3302.	566.	95.0	814.0	14.7	25.8	535.
LOUISIANA	VI	62.	56.	47.	34.	6.	1.0	8.5	.2	.3	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	944.	851.	722.	524.	90.	15.1	129.3	2.3	4.1	85.
MASSACHUSETTS	I	12480.	11256.	9543.	6933.	1187.	199.4	1709.3	30.8	54.2	1123.
MICHIGAN	V	2697.	2432.	2062.	1498.	257.	43.1	369.4	6.7	11.7	243.
MINNESOTA	V	11449.	10327.	8755.	6361.	1089.	183.0	1568.1	28.3	49.7	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	318.	287.	243.	177.	30.	5.1	43.6	.8	1.4	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	255.	230.	195.	142.	24.	4.1	35.0	.6	1.1	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	1191.	1074.	910.	661.	113.	19.0	163.1	2.9	5.2	107.
NEW JERSEY	II	5011.	4519.	3832.	2784.	477.	80.1	686.3	12.4	21.7	451.
NEW MEXICO	VI	832.	750.	636.	462.	79.	13.3	113.9	2.1	3.6	75.
NEW YORK	II	20103.	18132.	15373.	11168.	1913.	321.3	2753.5	49.7	87.2	1809.
NORTH CAROLINA	IV	2836.	2558.	2168.	1575.	270.	45.3	388.4	7.0	12.3	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	4782.	4313.	3657.	2657.	455.	76.4	655.0	11.8	20.8	430.
OKLAHOMA	VI	2503.	2258.	1914.	1391.	238.	40.0	342.9	6.2	10.9	225.
OREGON	X	670.	605.	513.	372.	64.	10.7	91.8	1.7	2.9	60.
PENNSYLVANIA	III	2892.	2608.	2211.	1607.	275.	46.2	396.1	7.1	12.5	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	1007.	908.	770.	559.	96.	16.1	137.9	2.5	4.4	91.
SOUTH DAKOTA	VIII	489.	441.	374.	272.	47.	7.8	67.0	1.2	2.1	44.
TENNESSEE	IV	740.	668.	566.	411.	70.	11.8	101.4	1.8	3.2	67.
TEXAS	VI	7626.	6878.	5832.	4237.	726.	121.9	1044.5	18.8	33.1	686.
UTAH	VIII	1105.	997.	845.	614.	105.	17.7	151.4	2.7	4.8	99.
VERMONT	I	280.	253.	214.	156.	27.	4.5	38.4	.7	1.2	25.
VIRGINIA	III	467.	421.	357.	259.	44.	7.5	64.0	1.2	2.0	42.
WASHINGTON	X	3165.	2855.	2420.	1758.	301.	50.6	433.5	7.8	13.7	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	851.	768.	651.	473.	81.	13.6	116.6	2.1	3.7	77.
WYOMING	VIII	474.	428.	362.	263.	45.	7.6	64.9	1.2	2.1	43.
TOTALS		153000.	138000.	117000.	85000.	14558.	2445.0	20956.0	378.0	664.0	13769.
REGION I		20256.	18270.	15490.	11253.	1927.	323.7	2774.4	50.0	87.9	1823.
II		25114.	22652.	19205.	13952.	2390.	401.3	3439.8	62.0	109.0	2260.
III		6712.	6054.	5133.	3729.	639.	107.3	919.3	16.6	29.1	604.
IV		13872.	12512.	10608.	7707.	1320.	221.7	1900.1	34.3	60.2	1248.
V		29310.	26436.	22413.	16283.	2789.	468.4	4014.5	72.4	127.2	2638.
VI		12208.	11011.	9335.	6782.	1162.	195.1	1672.1	30.2	53.0	1099.
VII		2141.	1931.	1638.	1190.	204.	34.2	293.3	5.3	9.3	193.
VIII		9341.	8425.	7143.	5190.	889.	149.3	1279.4	23.1	40.5	841.
IX		30880.	27853.	23614.	17156.	2938.	493.5	4229.6	76.3	134.0	2779.
X		3165.	2855.	2420.	1758.	301.	50.6	433.5	7.8	13.7	285.

trends within each 4-digit SIC classification, based on 1967 and 1972 Census of Manufactures [5] data, provided the production employee estimates for 1975, 1977, and 1983.

The total quantity of current process wastes in SIC 355 and SIC 357 is 269,000 kkg/yr (307,000 tons/yr) on a wet basis 236,400 kkg/yr (260,600 tons/yr) on a dry basis and 90,700 kkg/yr (100,000 tons/yr) on a wet basis, 62,200 kkg/yr (68,600 tons/yr) on a dry basis, respectively. Based on engineering judgment, the accuracy of the waste quantity estimates are probably correct to ± 30 percent.

The basic unit used to calculate the various national, regional and state quantities for total industry waste, process waste streams, potentially hazardous waste streams and potentially hazardous constituents was the average weight of all wastes per process area employee generated within the six significant process areas. The reasons for grouping all wastes from a process together for quantification purposes are two-fold. First, the most commonly available and reliable waste generation estimates were those for total waste volumes in discrete process areas. Some estimates were available for specific waste materials, such as solvents, within a process area. In general these material estimates are limited in coverage and accuracy so are considered useful only in apportioning the total process area waste quantities ("waste stream" as used here) to their various material components. The waste streams as identified by the process area from which they are generated, the typical waste stream component materials, and waste generation factors for waste streams and components are listed in Table III-30.

The second reason for grouping process wastes according to process area was that waste segregation in typical plants for both industries is practiced, if at all, according to process area, not according to waste material. The national total of waste streams generated by each manufacturing process was estimated using the following expression:

> National waste quantity = (No. of processes used in the industry) x (Average number of productions employees per process) x (Average amount of waste generated per year for each production employee).

The number of processes used in SIC 355 and 357 were taken from Table II-7, and the average numbers of employees per process were calculated from data compiled during the plant surveys. The average waste generation factor for each process was also calculated from the compiled plant survey data base.

Allocations of process wastes to the states were made as

TABLE III-30

WASTE GENERATION FACTORS

Waste Stream	Components	Waste Generation Factor kkg/yr - Dept. emp.	Average Number of Production Employees PU Process	
			SIC355	SIC357
*Machine Shop	Coolants	1.29	16	68
	Sweepings & Grindings	1.25		
	Solvents	0.81		
*Heat Treating	Quench Oils	0.85	26	74
	Cyanides	0.14		
	Acids/Alkalies	1.00		
*Electroplating	Heavy Metal Sludges	1.88	44	118
	Solvents	0.64		
	Acids/Alkalies	1.00		
*Coating	Paint Sludge	0.55	14	33
	Solvents	0.50		
Ferrous and Non-Ferrous Foundry	Foundry Sand	62.0	24	55
Plastic Molding	Scrap Resin	0.12	0	4

*Potentially hazardous waste source

Source: Contractor estimates

follows:

> State waste quantity = (National waste quantity) x (Percent of production workers in each state in SIC 355 and 357).

The percentage of production workers in each state for each SIC code was derived primarily from 1972 Census data.

Metal foundries — ferrous and nonferrous — constitute the largest process waste stream in SIC 355 generating 173,000 kkg/yr (190,000 tons/yr) and the smallest waste stream is electroplating at 3700 kkg/yr (4100 tons/yr) — all on a wet weight basis. Although ferrous and nonferrous foundry operations are not typically found in SIC 355 plants, Table III-9 shows that the quantity of waste generated in casting operations is significant, constituting nearly two-thirds of the total process wastes of the industry. Electroplating wastes are relatively small both because of the small number of electroplating processes utilized in SIC 355 plants and the small size of the processes employed. Machine shop wastes are significant for precisely the reverse reasons. Machining is one of the typical processes found in SIC 355 plants and some of these operations are quite large.

Machining shops account for the largest waste stream in SIC 357, 39,000 kkg/yr (43,000 tons/yr) wet weight and the smallest in this industry is coating at 3500 kkg/yr (3800 tons/yr) wet weight. The machine shop is a typical process in SIC 357 plants while coating is not. In addition, many of the coating operations involve only hand application or small dry-wall spray booth operations which do not generate the sludge produced by wet-wall booths. Electroplating wastes are significant because of the relatively large size of these operations as employed in SIC 357 plants. Although ferrous and nonferrous foundries are not typical in SIC 357 plants, the total waste is significant because of the high quantity of foundry sand generated in casting operations. Foundry wastes are not considered potentially hazardous.

Each waste stream in SIC 355 with the exception of electroplating and plastics molding is larger than its counterpart in SIC 357. Some of the reasons which explain this have been discussed earlier — i.e., there are more plants in SIC 355 than in SIC 357. In addition, SIC 357 employs more and larger electroplating shops than SIC 355 plants and plastics molding operations are very rare in SIC 355. On the other hand, many of the products manufactured in SIC 355 are much larger in size than typical SIC 357 products and operations common to both would tend to be on a larger scale in SIC 355.

The national waste generation estimates for SIC 355 and 357 show a decrease between 1975 and 1983. This is concomitant with an overall reduction projected in production employees. These projections were developed by the contractor based on 1958-1972 Census statistics, the U.S. Industrial Outlook for 1973 and 1974, and experience factors. This indication that these industries are in a decline is supported by the plant survey experience. Many of the plants contacted reported that they were in the process of phasing out or reducing production of some SIC 355 and SIC 357 products due to the the prevailing economic climate. The only industry in SIC 355 that has expanded in recent years is SIC 3553, woodworking machinery manufacture. The only growth industry in SIC 357 is SIC 3573, electronic computer equipment manufacture.

The reduction in estimates of national waste totals is more sizeable in SIC 355 than in 357 between 1975 and 1983. This is largely due to the fact that the decline in SIC 357 is balanced to a considerable degree by the explosive expansion of SIC 3573, electronic computing equipment manufacture.

The 1983 national total incorporates the effects of the 1972 amendments to the Federal Water Pollution Control Act. The Act requires designated industries to meet one level of limitations on the pollutant parameters of their effluents by 1977 and another, usually more stringent level, by 1983. These reductions may, in some cases, be brought about by process change or internal methods such as water recycle. The latter practice is anticipated to some extent in the case of electroplating effluents and acid and alkaline cleaning solutions. However, regardless of whether these effluents are treated for reuse or are treated for discharge in order to meet the regulatory requirements, larger quantities of sludge will be generated which will require land disposal. Thus, the 1983 total includes material which is generally disposed of today by discharging effluent to sanitary sewers. These estimated quantities have a greater impact on projected national totals in SIC 357 than in SIC 355 because the SIC 357 category plants use larger volumes of water than SIC 355. The biggest water user in these industries is SIC 3573, electronic computer equipment manufacture, which uses on the average four times as much water as the second largest water user, SIC 3552, textile machinery [29].

Estimates of Potentially Hazardous Waste Quantities

Quantifications of hazardous constituents in the wastes of the SIC 355 and 357 industries are based on plant survey data and laboratory analyses conducted on waste samples obtained from surveyed plants. These constituents contaminate the nonhazardous constituents of a larger body of wastes, thereby rendering the whole waste stream potentially hazardous. Thus, since the hazardous constituents are distributed throughout the waste stream and are not segregated in waste handling, the quantity of potentially hazardous wastes, as defined previously, is in most cases identical to the total waste stream. However, in the 1983 estimates, the quantities of total waste become greater than the potentially hazardous portion because the total waste includes suspended solids, currently discharged in plant effluents, which are not potentially hazardous.

The dry weight quantities of potentially hazardous wastes are greater than the dry weight quantities of hazardous constituents, because hazardous and nonhazardous constituents are often chemically bound together.

In SIC 355 and 357, the largest potentially hazardous waste is machine shop wastes, 79,000 kkg/yr (87,000 ton/yr) for SIC 355 and 39,000 kkg/yr (43,000 ton/yr) for SIC 357. These quantities are on a wet weight basis. This is because of the prevalence and size of machine shops and related processes in these industries. The largest hazardous constituent in machine shop wastes is metal sweepings and grindings which is followed by flammable solvents. In SIC 355, sweepings and grindings, which are found only in the machine shop waste stream, are the largest hazardous constituent, and the largest hazardous constituent in SIC 357, up until 1983, is flammable solvents generated in the machine shop, electroplating, and coating waste streams. One of the smallest volume hazardous constituents, heavy metals, includes quantities of cadmium, chromium, and lead.

The 1983 effluent limitations will necessitate greater removal of heavy metals, oil, and cyanides from plant wastewater effluents. The largest hazardous constituent affected by the proposed 1983 regulations will be oil as shown in Tables III-20 and III-23. It is estimated that the quantity of oils for disposal will be increased two and a half times in SIC 355 and seven times in SIC 357 due to the impact of the 1983 effluent guidelines. This will result in waste oil becoming the largest hazardous constituent in SIC 357 in 1983.

Estimates of state and EPA regional totals are presented for SIC 355 in Appendix I and for SIC 357 in Appendix J. These are based on the production employee distribution by state found in the 1972 Census data [5]. This distribution is assumed to be the same in 1977 and 1983 and therefore is used to determine state quantities in those years. The states which have the most plants and production employees are considered to have the largest quantities of total process and potentially hazardous wastes generated within their borders. These appendices, along with Tables III-24 through III-29, show that in SIC 355, Ohio has the greatest process waste generation at 26,851 kkg/yr (29,598 tons/yr) on a wet basis. The next largest process waste and potentially hazardous waste quantities are estimated to occur in Massachusetts, Pennsylvania, Illinois, California, New Jersey, New York, North Carolina, and Wisconsin, respectively. These states are generally considered to be highly industrialized. Two states — Alaska and Idaho — were considered to have no SIC 355 manufacturing operations based on Census data. Hawaii, Montana, Nevada, New Mexico, North Dakota, South Dakota, and Utah all have less than 187 kkg/yr (206 tons/yr) of total process wastes generated by their respective industrial operations in SIC 355.

EPA Region V has the greatest amount of process and potentially hazardous waste generated at 78,948 kkg/yr (87,025 tons/yr) and 28,175 kkg/yr (31,058 tons/yr). Region V contains Ohio (which has the largest SIC 355 waste generation of any state), Indiana, Illinois, Wisconsin, Minnesota, and Michigan. EPA Region IV, consisting of the Southeastern states — Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Florida — has the next largest quantities of process wastes and potentially hazardous wastes at 44,679 kkg/yr (49,250 tons/yr) and 15,945 kkg/yr (17,576 tons/yr) on a wet basis, respectively. The smallest quantities of process wastes and potentially hazardous wastes are generated in EPA Region VIII, which consists of Montana, North Dakota, South Dakota, Wyoming, Utah, and Colorado. This region accumulates 1246 kkg/yr (1373 tons/yr) of process wastes and 445 kkg/yr (491 tons/yr) of potentially hazardous wastes on a wet basis.

The current distribution of SIC 355 wastes among the states and EPA regions is not expected to change through 1983.

In SIC 357, California has the most wastes with 16,831 kkg/yr (18,553 tons/yr) of total process wastes and 11,609 kkg/yr (12,797 tons/yr) of total potentially hazardous wastes. New York has the next highest totals with 12,706 kkg/yr (14,006 tons/yr) of process waste and 8764 kkg/yr (9661 tons/yr) of potentially hazardous wastes on a wet weight basis. A number of states are thought to have no plants which manufacture office computing and accounting machinery based on Census data [5]. These are Alaska, Hawaii, Idaho, Maine, Mississippi, Montana, Nevada, North Dakota, Rhode Island, and West Virginia.

EPA Region IX has the greatest quantities of SIC 357 process waste at 19,517 kkg/yr (21,514 tons/yr) and potentially hazardous wastes at 13,461 kkg/yr (14,838 tons/yr), all of which are on a wet basis. Region IX is made up of California (which generates 86 percent of the SIC 357 wastes), Nevada, Arizona and Hawaii. Region IX is followed closely by EPA Region V which accumulates 18,525 kkg/yr (20,420 tons/yr) of total process waste and 12,778 kkg/yr (14,085 tons/yr) of potentially hazardous wastes. The smallest amounts of potentially hazardous wastes are found in Regions VII and X at 934 kkg/yr (1030 tons/yr) and 1380 kkg/yr (1521 tons/yr) on a wet basis, respectively.

Residues From Pollution Abatement Equipment

Part of the process wastes generated by the special industrial machinery and office, computing, and accounting machines manufacturing industries are from air and water pollution control devices as shown in Table III-31. In the foundry process, approximately 1.5 percent of the wastes generated are from collected dust from furnaces stack gas. This amounts to 2600 kkg/yr (2900 tons/yr) of dust in SIC 355, and 400 kkg/yr (400 tons/yr) in SIC 357. These materials have not been classified as potentially hazardous.

Much of the electroplating wastes originate from water pollution abatement devices such as clarifiers. About 75 percent of the electroplating wastes generated in 1975 were generated in this manner, and it is expected that roughly 90 percent of the wastes in 1983 will stem from wastewater treatment operations as a result of improved imposed effluent guidelines. During 1975 in SIC 355, about 2800 kkg/yr (3100 tons/yr) of total process waste resulting from wastewater treatment, all of which is considered potentially hazardous, was generated. By 1983, 7200 kkg/yr (7900 tons/yr) of process waste from wastewater treatment will accrue. Approximately 3000 kkg/yr (3300 tons/yr) of this volume are potentially hazardous. In SIC 357, about 16,500 kkg/yr (18,200 tons/yr) of process waste, classified as potentially hazardous, is generated from water pollution control equipment. In 1983, the process waste will increase to about 27,000 kkg/yr (29,800 tons/yr) which will contain 17,300 kkg/yr (19,100 tons/yr) of potentially hazardous waste.

Part of the coating waste stream is made up of sludge from water pollution control equipment and from discarded air filters from dry wall paint booths. In SIC 355, these wastes will constitute 1000 kkg/yr (1100 tons/yr) and 1300 kkg/yr (1400 tons/yr) in 1975 and 1983, respectively. The residues from pollution control equipment in SIC 357 are estimated at 400 kkg/yr (400 tons/yr) in 1975 and 1700 kkg/yr (1900 tons/yr) in 1983.

The wastes from the other manufacturing processes in these industries generally do not have air or water pollution abatement equipment. This applies to machine shops, heat treating operations, assembly, plastics molding operations, and stamping, blanking, and forming operations.

TABLE III-31

PROCESS WASTE GENERATION FROM AIR AND WATER POLLUTION CONTROL DEVICES
(kkg/yr)

	Total Process Waste	Potentially Hazardous Waste	Total Process Waste	Potentially Hazardous Waste
1975				
Foundries-Ferrous (A) and Nonferrous	2600	0	400	0
Electroplating (B)	2800	2800	16,500	16,500
Coating (D)	1000	1000	400	400
Total	6400	3800	17,300	16,900
1977				
Foundries-Ferrous (A) and Nonferrous	2400	0	300	0
Electroplating (B)	2800	2800	16,500	16,500
Coating (D)	900	900	400	400
Total	6100	3700	17,200	16,900
1983				
Foundries-Ferrous (A) and Nonferrous	1800	0	300	0
Electroplating (C)	7200	3000	27,000	17,300
Coating (E)	1300	900	1,700	1,700
Total	10,300	3900	29,000	19,000

Notes: (A) Dry weight = weight weight. (B) Dry weight - 0.40 x wet weight.
(C) Dry weight = 0.62 x wet weight. (D) Dry weight = 0.77 x wet weight.
(E) Dry weight = 0.85 x wet weight.

SECTION IV

TREATMENT AND DISPOSAL TECHNOLOGY

INTRODUCTION

This section describes the technologies utilized by plants in SIC 355 and 357 to treat and dispose of potentially hazardous wastes generated in the manufacture of special industrial machinery and office, computing, and accounting machines, respectively. Current treatment and disposal technologies are developed for the four basic process waste streams deemed potentially hazardous. The processes involved are: (1) machine shop operations, including tool and die shops; stamping, blanking and forming operations; and plate and structural fabrication; (2) heat treating operations; (3) electroplating operations; and (4) coating operations. Descriptions of these processes and their waste quantities and characteristics are presented in Section III. This section does not attempt to describe the treatment and disposal methods applied to process wastes considered to be nonhazardous by the contractor.

Three levels of technology are indicated for each of the potentially hazardous waste streams. These are based on the most prevalent industrywide practice (Level I); the best method presently used which is amenable to more widespread use (Level II); and the disposal practice required to provide adequate health and environmental protection (Level III).

No differentiation is made between treatment and disposal technology use by plants in SIC 355 and 357. Each of the four potentially hazardous waste streams identified above are found in both SIC 355 and 357 manufacturing establishments. The plant survey data showed that the handling, treatment and disposal practices used in the manufacturing establishments of both SIC 355 and SIC 357 are identical. Both industries generally rely on private contractors to haul away and dispose of potentially hazardous wastes in offsite sanitary landfills. A discussion of onsite versus offsite treatment and disposal practices is provided in this section along with a description of the operations of private disposal contractors. The treatment and disposal practices of typical plants in SIC 355 and 357 are described, as are the three levels of treatment and disposal technology for each potentially hazardous waste.

PRESENT WASTE HANDLING AND TREATMENT TECHNOLOGIES

Several types of potentially hazardous wastes generated by manufacturing plants in SIC 355 and 357 are handled and treated, either onsite or by contractors at offsite locations. Onsite treatment will necessarily increase in the foreseeable future as the Federal limitations discussed in Section III are imposed on the pollutant constituents of the liquid wastes generated by these industries.

The specific wastes currently receiving some form of treatment, in the surveyed plants include cooling, cutting, quenching, lubricating, and hydraulic oils, organic solvents, electroplating baths, and acid and alkaline cleaning solutions. Physical, mechanical, and chemical treatment methods are all employed as applicable. No biological treatment is practiced in the SIC 355 and 357 plants or envisioned under EPA's effluent limitations and standards since no organic wastes other than oil and solvents are generated.

Machining Waste

In many machine shops in the SIC 355 and 357 categories, coolants and cutting oils are reused until they are too degraded, as discussed in Section III, to be suitable for further recirculation and are then discarded. However, the surveys disclosed that in six plants out of the 33 visited, coolants and cutting oils are completely or almost completely recirculated. This is accomplished in most cases by filtering the oil, sewering small quantities of sludge, and disposing of the filters in sanitary landfills; in some instances, both the sludge and filters are landfilled. In one surveyed plant, cutting oil is reclaimed through the use of a centrifuge, and small volume residue is incinerated. The management of three plants claimed that their cutting fluids are completely recirculated in their machining operations.

Spent lubricating and hydraulic oils are filtered in one plant prior to burning them with fuel oil in the plant boiler. This practice is also reported in use in plants of a very large corporation with multi-plant operations in both SIC 355 and 357. Only the sludge remains for disposal off-site in a sanitary landfill. Two plant spokesmen reported that their disposal contractors reclaim cutting oils and quenching oils prior to selling them as fuels or fuel additives.

The treatment of organic solvents — either onsite or offsite — for the purpose of reusing them was not found to be as prevalent in the surveyed plants as might have been expected based on experience with other types of industrial operations such as the paint and coatings industry. However, two instances of contractor recovery and three of onsite recovery of spent solvents from machine shop, coating, or heat treating operations were reported. It is not known whether this represents typical distribution of solvent recovery in

SIC 355 and 357 plants. The large manufacturer referred to above indicates use of on-site stills for solvent reclamation, but this process would not be economical for the very small plants which constitute a large majority of SIC 355 and 357 operations as discussed in Section II. In some cases, the quantities of discarded solvents are so minimal that they are absorbed by cleaning cloths which are laundered so that the solvents do not constitute a liquid or semi-liquid waste. In others, the solvents appear in trace quantities only in discarded oils. In such cases as these, segregation for reclamation even by decantation is not practical.

No treatment is generally afforded to sweepings and grindings waste other than separating out large pieces of metal suitable for offsite scrap salvage by others. As noted in Section III, scrap metal is not considered a waste.

Electroplating Wastes

Liquid waste equalization and metals recovery applied to electroplating as well as heat treating and other metal finishing wastes account for the bulk of treatment which occurs on-site in SIC 355 and 357 plants. This is true for several reasons. One is that spent plating, etching, and similar baths and rinses may contain metals which are very costly. Therefore, even though treatment is expensive, it is more economical in some cases than discarding metals such as copper, chrome, gold, silver, and rhodium contained in the wastes. Another reason is that the surface finishing wastes account for most of the liquid wastes generated in SIC 355 and 357 plants and they are most conveniently disposed of by discharging them to a sanitary sewer. However, if the heavy metal content is not removed or considerably reduced, the metals could damage mechanical equipment in sewage treatment plants and kill the microorganisms used in biological treatment. Discharge of wastewater effluents to receiving waters presently requires heavy metal removal to meet water quality criteria and standards, and, in the future, stricter effluent limitations and standards will likely be applied. The third reason for on-site treatment of wastewaters is that many finishing operations and heat treating involve the use of cyanide salts which, because of their high degree of toxicity, should be destroyed before disposal.

The electroplating wastes of seven of the nine plants surveyed which engage in this process receive some sort of on-site treatment. In two cases, these waste streams also included etchants. Some plants practice some degree of segregation according to the nature of the waste, although segregation does not appear to be a universal practice. Most treatment of electroplating waste can be considered batch treatment though some qualified as semi-continuous.

The electroplating area in one of the surveyed plants is equipped with an ammonium hydroxide floor drain system to neutralize cyanide spills which may occur. Hypochlorite salts are used to destroy cyanides in the treatment system, although chlorine is used for this purpose in some other plants, and in one, electrolytic destruction of cyanide is practiced. Under proper conditions, chlorine will react with a cyanide salt, such as sodium cyanide, to form carbon dioxide, sodium chloride, nitrogen, and water. This treatment is feasible for plants of all sizes. An estimated 25 percent of electroplating operations in the subject industries practice cyanide destruction.

The degree of treatment of these wastes and the size of the equipment is directly related to waste quantity and strength. The smaller plants have found it more economical to drum the quantities they produce and have them hauled, untreated, to off-site sanitary landfills. In any size plant where the concentrations of metals are so dilute as to make recovery of them unecomomic and the waste stream is acceptable for discharge, this is the natural course pursued. Wastewater treatment plants as described above would not be economically feasible for many of the plants in the subject industries due to the large proportion of relatively small plants and their correspondingly due small waste volumes.

Some less complete treatments of electroplating or etching wastes were encountered. One involves reclamation of a ferric chloride solution through precipitation to recover its copper content. In another, dilute chrome and cyanide rinses are subjected to neutralization and pressure filtration with the filtrate going to a sanitary sewer and the filter cake hauled to a sanitary landfill.

In many instances acid and alkaline wastes are neutralized before discharge to sewers, constituting the general practice of the industry. In one case, 30 percent sulfuric acid bath solutions, fluoroboric acid, and hydrochloric acid are diluted with rinse water before discharge, and in others the solutions were sewered apparently without treatment.

Heat Treating Wastes

As noted earlier, cyanide wastes from heat treating operations undergo chemical destruction in about 25 percent of the plants generating this waste. Where both heat treating and electroplating are utilized in the same plant and both employ cyanides (roughly 50 plants in the subject industries) common practice appears to be that the liquid cyanide wastes from both are combined and destroyed in the same treatment process. However, based on extremely limited survey data, it appears that where cyanide is used only in heat treating, contractor treatment or disposal may occur more frequently (perhaps in 75-100 plants). Off-site contractor landfill is typically applied for untreated cyanides in liquid form, but cyanides in solid or semisolid residues may be chemically destroyed by offsite incineration.

Painting Wastes

Only one plant reported treatment of waste paint. The sludge from the water cascade of a wet-wall spray booth is sent to the cyanide equalization tank on the premises. However, this practice is not considered common. Waste solvents, paint sludge, air filters, and oils, which are the main constituents of paint waste, are generally combined in drums or waste contained with no treatment.

New Developments

The plant surveys revealed that the following hazardous waste treatment methods are being considered for future use by one or more manufacturing establishments:

1. Chromium plating waste removal by lime precipitation
2. Acid/alkali plating waste neutralization
3. Solvent reclaiming by activated carbon adsorption

A wide range was found in the degree of sophistication of waste disposal practices in the surveyed plants. This degree of sophistication is strongly related to plant size and is increased in some cases by corporate policies toward environmental protection. For example, managers of plants with extensive treatment facilities pointed out that they have corporate support in substantial expenditures for environmental controls-support which is made possible by the large size of the company. This support is not available to the small one-plant company which must cope with the same types of wastes but in smaller volumes. Plant location in terms of highly urbanized areas as opposed to small towns is another determinant in waste disposal practices, and is probably related to the extent to which official supervision over such matters is practiced — i.e., the more primative practices of on-site land disposal occurring in non-urban locations are not likely to be permitted in metropolitan areas.

The degree of segregation of waste streams is also widely varied from plant to plant. This is also largely a function of size. For example, a small plant is likely to place all waste oils in one drum, all waste solvents in another drum, and all process solid wastes generated on the site in one trash container regardless of which process generated them. In addition, all oils and solvents to be disposed of may find their way ultimately into the same drum, depending upon relative quantities. Also, the amount of these materials discarded is so small in some cases that they may be combined with the solid wastes for disposal.

This would not be likely to occur in a large plant where reclamation and recycle are more economically feasible. In the larger plants, the various different elements of waste streams as they are defined in this report — all wastes emanating from a separate manufacturing process — are generally segregated as waste oils, waste solvents, solid wastes, etc. This is due to one or more factors — (1) to facilitate recovery of each separate type of material; (2) to avoid dilution which would hinder recovery; (3) to avoid accidents in the case of more exotic wastes; or (4) to accommodate separate pick-up by specialized disposal or reclamation contractors.

One of the surveyed plants used nine waste contractors: two different contractors purchase 90 and 10 percent of a cupric oxide stream for recovery of the copper; precious metal baths are sold for refining to four separate companies on a bid basis; floor sweepings and general scrap are collected by a disposal company for landfilling; spray booth paint sludge is hauled to landfill by another company; metal sludges from the chemical treatment system are landfilled by still another.

The number of contractors involved ranges down to none where waste quantities are small and unsupervised on-site land disposal occurs. There are insufficient plant data available to correlate number of contractors utilized to any given range of plant size, however.

Machining Waste Disposal

Contractor delivery to off-site sanitary landfills appears to be the most common disposal technology for coolants, cutting oils, and the small intermittent quantities of lubricating, hydraulic, and quenching oils discarded. About 1000 plants are estimated to utilize this practice. Six surveyed plants reported contractor landfill disposal of waste oils generated by machine shops and other machining operations, and one reported this disposal means for quenching oil from heat treating. In another instance, the contractor's method of disposal of quenching oil was not known to the plant as was the case in the disposal of three coolant and cutting oil disposal contractors. These are probably landfill operations as well as small local companies. Only one instance of contractor incineration was reported for oils. Off-site sanitary landfilling of waste oils from machine shops was the reported technology for one-third of the surveyed plants.

Other methods reported for disposing of oils are:

Completely or almost all recirculated (Coolants, Cutting oils)	4 plants
Nevel discarded (quenchants)	2 "
Contractor reclamation	2 "
Sent out with metal wastes	3 "
On-site land disposal	5 "
Sewered	4 "
Used as fuel on-site	4 "
Contractor road oiling	2 "
Given away to employees	1 "

Some plants employ more than one of these technologies.

Metal sweepings and grindings also are apparently most often discarded in sanitary landfills off-site by contractors although only four plants reported this practice directly. However, dusts and grindings most often go out of the plant in waste oils or are added to the general trash for solid waste disposal. The most prevalent disposal practice for metal sweepings and grindings is off-site sanitary landfill disposal by contractor whether the waste is mixed with other wastes or segregated.

This also applies to spent organic solvents from machining and painting operations. Six contractor landfill operations were reported along with one instance in which the disposal technology was unknown. Two contractor incineration operations were reported. On-site land disposal is practiced at three plants. In two of these cases solvents were mixed with discarded oils.

Electroplating Waste Disposal

Contractor disposal in sanitary landfills also appears to be prevalent practice for heavy metal sludges generated from electroplating operations with six plants reporting the practice. In one specialized case in SIC 357, 2300 liters (600 gal.) per year of an arsenic/selenium alloy sludge is placed in sealed drums for contractor burial off-site. In one other case, the sludge is sewered.

The primary means of treatment and disposal for acid and alkaline cleaners appears to be on-site neutralization and sewering to municipal sewage treatment plants. Only two instances of contractor disposal in sanitary landfills were reported for cleaners — one direct and one after treatment.

Heat Treating Waste Disposal

Waste oils and cyanides from heat treating operations are most commonly deposited in off-site sanitary landfills by private contractors. About 150 plants in SIC's 355 and 357 are estimated to use this technology. In addition, about 50 plants generating solid cyanide wastes arrange for private contractors to burn their wastes in off-site incinerators.

Painting Waste Disposal

Contractor disposal in sanitary landfills is the predominant disposal technique for paint wastes generated by SIC 355 and 357 plants. This is in accord with the findings on disposal of paint wastes in a previous EPA study [55], involving practices in the paint industry itself and factory-applied coatings operations. Thirteen SIC 355 and 357 plants out of 33 surveyed report this practice. However, three plants indicated utilization of contractor incinceration operations, and two dump their paint wastes on-site.

ON-SITE VS. OFF-SITE TREATMENT AND DISPOSAL

The principal methods for on-site waste disposal discovered in the plant surveys involve burning of waste oils as boiler fuel after filtering, if necessary, which occurs in three plants. No on-site, supervised land disposal operations were encountered. Where on-site land disposal of oil, waste metals of various sizes, waste paint, and in one case, solvents, takes place, it is usually "dumped" on the soil. In addition, at one establishment paint wastes are placed in an alley behind the plant to be washed away by rain; in another case, oils are spread on the driveway to reduce dust. These on-site disposal methods are not considered environmentally acceptable.

There is no indication that any of the plants surveyed plan to change their disposal mode with regard to on-site or off-site location in the foreseeable future. Thus, no significant increase in on-site disposal practices, either using incineration or landfills, is expected through 1983. No spokesman discussed changes in this regard relating to increased wastes requiring land disposal or incineration engendered by 1977 and 1983 effluent limitations and standards.

It is estimated that 90,800 kkg/yr (100,100 tons/yr) and 63,600 kkg/yr (70,100 tons/yr) of potentially hazardous wastes undergo off-site disposal at the hands of private contractors in SIC 355 and SIC 357, respectively. This represents approximately 90 percent of the total potentially hazardous waste generated by the industries as shown in Table IV-1.

SAFEGUARDS USED IN DISPOSAL

At each of the plants surveyed the question was asked: "Are

TABLE IV-1

ONSITE AND OFFSITE DISPOSAL OF POTENTIALLY HAZARDOUS WASTES

	1975 WASTE QUANTITIES, kkg/yr.(2) (Wet Weight)			
	SIC 355		SIC 357	
	Onsite	Offsite	Onsite	Offsite
Machine Shop(1)	8,000	71,000	4,000	35,000
Electroplating	400	3,300	2,200	19,800
Heat Treating	800	7,500	600	5,600
Painting	1,000	9,000	300	3,200
TOTALS	10,200	90,800	7,100	63,600

(1) Includes wastes from tool and die shops; stamping; blanking, and forming shops; and plate and structural fabrication operations.

(2) The wet and dry weight factors used in deriving these waste quantities are approximate and may vary with given manufacturing operations and with any waste dewatering systems used.

Source: Contractor estimates

potentially hazardous wastes handled or treated differently from other solid or semi-solid wastes?" Twenty responded that they are not, although in many of these cases the spokesman did not consider any of the wastes produced potentially hazardous.

The thirteen affirmative answers were based on the following factors:

1. All chemical wastes and plating sludges are handled by a specialized contractor.

2. The metallic content of solvents, paint sludges, and other chemical wastes are handled by different contractors from those disposing of innocuous wastes.

3. Spent coolants are separately drummed prior to disposal.

4. Ferric chloride solution is reclaimed by copper precipitation; acid solution is then diluted before disposal.

5. Use private contractor for disposal of chemical sludges; sealed drums and burial for arsenic selenium alloy sludge.

6. Cyanide is placed in labelled drums and handled by a separate contractor.

7. Machine shop coolant is discarded on-site.

8. Oils are drummed separately from other wastes.

9. Used chemicals are collected and separated by a hazardous material distribution system for disposal; treatment of electroplating wastes is practiced; hazardous parts of scrapped machines are removed and handled separately; approximately 30 drums/year of old capacitors containing PCB's are collected and stored; 2 drums/year of mercury are drummed and handled separately.

10. Oils and solvents are sent to landfill, while other nonhazardous solid wastes go to a scavenger service; some metallic wastes with oil residues are disposed of through a separate contractor.

11. Liquids and solids are removed and disposed of by licensed disposal companies.

12. Dilute plating chrome and cyanide rinses are reduced, oxidized, neutralized, and pressure filtered before discharge to sewer; concentrated plating and heat treated wastes go to a certified disposal contractor; paint and stripping wastes, ink-solvent wastes, and other paint related materials also go to a certified disposal

contractor.

13. Make-up supply for plating baths are provided by two drag-out catching tanks; copper solution is sent to a contractor for reclamation; gold rinses are countercurrent; heat treating, quenching oil and sodium cyanide are drummed and put in a general container for pickup.

It can be seen that there is a broad interpretation of which wastes are hazardous and of what constitutes "different" handling. On the basis of this information, it is not possible to establish the norm or the average of safeguards utilized by the plants in this industry in handling potentially hazardous wastes or the number of plants in which each of these safeguards are used.

PRIVATE CONTRACTORS AND SERVICE ORGANIZATIONS

It was specifically reported in only one instance that a plant's own trucks haul potentially hazardous wastes to a disposal site. It is understood that some of them make occasional and unscheduled trips to haul nonhazardous trash to a municipal disposal area, but it was not suggested that these loads contain the wastes defined as hazardous in this report with any frequency. Thus, although the plant surveys were very limited in number, it is felt that they establish the fact that the majority of the wastes generated by SIC 355 and 357 plants (about 90 percent) are carried away from the plant by private contractors.

A list of 52 contractors reported by the plants visited is shown in Appendix K. Their methods and capabilities vary quite widely. Sanitary landfill disposal is listed for 23 operations although this is not known to be accurate in every case. Only one operation is known to be a secured landfill. Six of the disposal contractors listed in Appendix K have incineration facilities; three reclaim solvents and three reclaim oil; 15 others recover metals. While some of the latter may not handle metal in the forms defined as hazardous in this report, there is generally insufficient information to draw a line between the activities of one type of business and another. As Appendix K indicates, some of the contractor companies engage in more than one treatment or disposal practice.

Four contractor organizations which serve SIC 355 and 357 plants were visited during the study. All of these are located in EPA Region V. Two operations collect waste oil. Depending on the quality of the oil, one either sells it to rerefineries or uses it for road oiling. That firm also collects crankcase oil from service stations. The second company of this type uses the waste oil for road oiling exclusively. This second firm also handles sewage from septic tanks which is spread over farm lands for fertilizer.

One facility visited handles most of the cyanide waste generated in a Region V metropolitan area. This amounts to about 264,950 liters (70,000 gal.) per year of liquid cyanide and an undetermined amount in solid form. The company has a state permit to incinerate the cyanide collected. This material caused the incinerator's refractory lining to deteriorate rapidly, however, and the equipment was not in operation at the time of the visit. It was reported by company personnel that combustion temperature was maintained at 900°C (1700°F). The incinerator has a cylindrical primary combustion chamber followed by a secondary chamber and apparently has demonstrated that it can comply with state air pollution standards without control equipment. This company also collects about 2,649,500 liters (700,000 gal.) per year of waste oil, most of which is burned as supplemental fuel in the incinerator. However, a small portion of the oil is treated with acid and/or heated using steam coils to effect solids and dirt precipitation. This reclaimed oil is then sold as a substitute for No. 3 grade fuel oil.

The other disposal facility visited is a large 19 million liter (5 million gal.) per year regional operation handling organic chemical wastes for several hundred customers in several states. It has the capability to transport both bulk liquids in tank trailers of approximately 19,000 liters (5000 gal.) each and drummed wastes on trailers. The company disposes of these wastes through an incineration process utilizing rotary kilns, liquid burners, and sludge incineration. It employs extensive air pollution control including two high-energy venturi scrubbers.

A good deal of information was obtained on the services of another more sophisticated disposal and recovery contractor in Region V through the survey of a large plant belonging to one of its customers. This facility provides oxidation-reduction, acidulation, neutralization, chemical detoxification, and thermal destruction of liquid wastes as well as oil and solvent recovery. Its fluidized bed incinerator is also equipped with a high energy wet scrubber. Analytical services are available to determine the appropriate methods and cost of disposal.

TREATMENT AND DISPOSAL AT TYPICAL MANUFACTURING ESTABLISHMENTS

Characteristics for Typical Special Machines Manufacturing Plants

A typical plant within SIC 355 was defined in Section III as a machine shop with attendant plate and structural fabrication facilities and painting operation located in a predominantly urban area where land is relatively scarce. As shown in Table III-4, the typical plant generates a total of 16.4 kkg/year (18.1 tons/year) of process wastes, all of which is considered potentially hazardous. These wastes are combined in a 15-cubic meter (20-cubic yard) trash container for collection by a private contractor at a frequency of once/week to once/month. The wastesare taken to an off-site sanitary landfill for disposal.

Characteristics for Typical Office, Computing, and Accounting Machines Manufacturing Plants

A typical plant in SIC 357, as stated in Section III, consists of a machine shop and an assembly operation. Approximately 14.4 kkg/year (15.9 tons/year) of process wastes are produced, all of which are classified as potentially hazardous. The wastes are combined in a trash container along with trash and garbage for collection by a private contractor who picks up the wastes on a prearranged time schedule. It is unlikely that the contractor picks up full loads from the plant although he probably charges the plant for pick-up and disposal at a fixed monthly rate. The wastes are hauled to an off-site sanitary landfill operation for disposal.

LEVELS OF TREATMENT AND DISPOSAL TECHNOLOGY FOR POTENTIALLY HAZARDOUS WASTES

The U.S. Environmental Protection Agency has defined three levels of treatment and disposal technology which are or may be applicable to potentially hazardous waste streams generated by the industries which manufacture special industrial machinery and office, computing, and accounting machines which are destined for land disposal. These technology levels are defined as follows:

Level I - The technology currently employed by typical facilities — i.e., broad average present treatment and disposal practice.

Level II - The best technology currently employed. Identified technology at this level must represent the soundest process from an environmental and health standpoint currently in use in at least one location. Installations must be commercial scale; pilot and bench scale installations are not suitable.

Level III - The technology necessary to provide adequate health and environmental protection. Level III technology may be more or less sophisticated or may be identical with Level I or Level II technology. At this level, identified technology may include pilot or bench scale processes providing the exact stage of development is identified.

The wastes from four processes in SIC 355 and 357 plants were designated as potentially hazardous in Section III. The characteristics of the wastes from machine shops, (including tool and die shops; plate and structural fabrication; and stamping, blanking, and forming) as practiced by these industries are identical, and these wastes were combined under the title "machine shop waste stream." The other potentially hazardous waste streams are heat treating, electroplating, and painting, for a total of four potentially hazardous waste streams.

The technologies identified in this section apply to the wastes of both SIC 355 and 357 plants. This is because no discernible differences were found in the wastes generated by each process which were due to or influenced by the characteristics of the SIC category. In addition, similar wastes generated in either classification are subject to the same methods of treatment, if any, and disposal.

The percentage of plants using each technology was estimated on the basis of survey data from 33 plants. This sample of establishments represents less than one percent of the production of special industrial machinery and office machines.

Definitions which apply to the technologies are as follows:

Sanitary Landfill - Land disposal facilities characterized by the spreading of waste in thin layers, compacted to the smallest practical volume and covered with soil at the end of each working day. They do not normally have special containment, monitoring, or provision for treatment of leachate.

Secured Landfill - Land disposal facilities characterized by impervious containment of the waste with provisions for monitoring and treatment of leachate if required. Adequate diversion and control of surface water are required as well as registration of the site for a permanent record of its location once filled.

Incineration - Combustion of an organic or partially organic waste stream with adequate means for complying with applicable air pollution control regulations and for disposal of collected particulate and ash (usually of a potentially hazardous nature) in a secured landfill.

Dump - a land site where solid waste is disposed without covering or containment.

The most prevalent current technology (Level I) for machine shop wastes is contractor disposal in off-site sanitary landfills. It is practiced by about 70 percent of the industry. Level II, the best technology currently in use, is recovery of oil by contractor for reuse off-site. Sweepings and grindings are placed in sanitary landfills. While some plants claim that they completely recirculate coolants and cutting oils, this is not established as a Level II technology since it is not achievable under all conditions of operation. Level III or environmentally adequate technology for machine shop wastes is the same as Level II except that secured landfill is required for sweepings, grindings, and sludge. The treatment and disposal technologies and pertinent considerations for machine shop wastes are set forth in Table IV-2.

Tables IV-3 through IV-6 show that contractor disposal in landfill is also Level I technology for the waste streams from electroplating, heat treating, and painting operations. Although Level II technology for each waste varies, Level III technology (the treatment and disposal method required for adequate health and environmental protection) is not currently practiced for any process waste stream deemed potentially hazardous. This is because secured landfills are not, to the contractor's knowledge, utilized by the industry.

Electroplating wastes are separated into heavy metal sludge and acid/ alkaline wastes. This is because acid/alkaline wastes are currently sewered to municipal wastewater treatment plants. Obviously, this does not constitute disposal on land; however, the inplementation of effluent guidelines pertaining to electroplating wastes will result in wastewaters and sludges which will be destined for land disposal by 1983. Level III technology for acid/alkaline wastes have thus been designated as disposal in secured landfills.

Tables IV-2 through IV-6 generally provide an overview of each process waste stream, its characteristics, and the treatment and disposal technology generally applied. The quantities of wastes handled in each technology level are provided along with amounts of residues from treatment stages. The numbers and percentages of plants implementing each technology level are estimated. Brief discussions are provided of the adequacy of technology, inherent problems or comments, non-land environmental impact, compatibility with existing facilities, monitoring and surveillance requirements, installation time, and energy requirements. The conclusions reached regarding these factors reflect the contractor's assessment of the current situation based primarily on the plant survey data and a literature search.

The technologies shown in the tables do not address in-plant practices or the potential for process or raw material change which could reduce either the quantities of wastes for disposal or their hazardous characteristics or both. However, the technologies will be greatly enhanced if innovative internal waste control technologies are more widely applied.

While good housekeeping practices were observed in virtually all surveyed plants, and management was especially sensitive to spills and leaks of costly materials, continued and expanded monitoring is a

TABLE IV-2

TREATMENT AND DISPOSAL OF MACHINE SHOP WASTES

FACTOR	LEVEL I (Prevalent Technology)	LEVEL II (Best Technology Currently Employed)	LEVEL III (Technology for Adequate Health and Environmental Protection)
Physical & Chemical Properties of Residual Wastes	Dirty oil containing metal salts, solvents, and dirt. Additives may contain hazardous constituents. Mixture of metal fragments and dusts which could readily dissolve forming hazardous substances	Oil-sludge mixture, possibly with lime or other filtration aid. Mixture of metal fragments.	Same as Level II
Description of Residual Waste	Viscuous liquid	Oily sludge with metal fragments.	Same as Level II
Factors Affecting Degree of Hazard	Some oils and heavy metal salts are toxic.	Heavy metlas salts or additives are toxic	Same as Level II
Treatment/Disposal Technology	Off-site Sanitary landfill	Off-site recovery of waste oils through rerefining. Residue to sanitary landfill. Off-site sanitary landfill of metal fragments.	Same as Level II
Amount of Potentially Hazardous Waste Currently Handled, kkg/yr wet weight	100,000	5,000	0
Amount of Residual Waste, kkg/yr wet weight	Not applicable	500	Not applicable
Estimated Number of Plants Using Technology	1000	50	0
Estimated Percentage of Plants Using Technology	70	<1	0

Table IV-2 - Cont'd.

FACTOR	LEVEL I (Prevalent Technology)	LEVEL II (Best Technology Currently Employed)	LEVEL III (Technology for Adequate Health and Environmental Protection)
Adequacy of Technology	Inadequate, Runoff or leaching of oils or metal salts may occur, contaminiting groudwater or surface water. Metal fragments may dissolve, contaminating nearby water bodies.	Same as Level I	Adequate assuming rerefining wastewater treatment.
Problems and Comments	Most inexpensive disposal method and readily available.	Oil	Few secured landfills available at this time.
Non-land Environmental Impact	Possible leachate and runoff problems.	Possible noise problems from rerefining operations. Water pollution could also result. Potential leachate and runoff problem from landfilled residue.	Possible noise problem from rerefining operation. Minimal impact assuming rerefining wastewater treatment.
Compatibility with Existing Facilities	Easily compatible. Need only collection receptable, hauler, and off-site landfill.	Rerefining operations more economical off-site. Compatible in this manner.	Same as Level II
Monitoring and Surveillance	None normally practiced.	Same as Level I	Wastewater generated requires monitoring.
Installation Time	None required	Same as Level I	Rerefining operation could require 1-1/2 - 3 years to build.
Energy Requirements	For hauling waste to disposal site and covering with fill	For hauling waste to rerefiner, pumping, hauling sludge to disposal site, and covering with fill	Same as Level II

TABLE IV-3
TREATMENT AND DISPOSAL OF ELECTROPLATING WASTES

FACTOR	Level I (Prevalent Technology)	LEVEL II (Best Technology (Currently Employed)	LEVEL III (Technology for Adequate Health and Environmental Protection)
Physical & Chemical Properties	Sludge containing 1-2 percent	Same as Level I	Sludge containing 20-50 percent total solids, some of which consist of heavy metal salts
Description of Residual Waste	Watery sludge	Same as Level I	Semi-solid sludge
Factors Affecting Degree of	Heavy metal salt are toxic	Same as Level I	Same as Level I
Treatment/Disposal Technology	Off-site sanitary landfill	Same as level I for sludge solvents to reprocessing with still bottoms disposed in sanitary land fill.	Sludge dewatering followed by secured landfilling.
Amount of potentiall hazardous waste currently handled, kkg/yr wet weight	16,000	Same as Level I	0
Amount of residual waste, kkg/yr wet weight	0	Same as Level I	Not applicable
Estimated number of plants using technology	60	Same as Level I	0
Estimated percentage of plants using technology	70	Same as Level I	0
Adequacy of Technology	Inadequate. Runoff or leaching of heavy metal salts may occur, contaminating ground water or surface water with toxic heavy metals.	Same as Level I	Adequate, assuming proper treatment/ disposal of wastewater which may contain heavy metal salts.
Problems and Comments	Most inexpensive disposal method and readily available.	Same as Level I	Filters or centrifuges can be used for dewatering. Few secured landfills available.
Non-land Environmental Impact	Possible leachate and runoff problems.	Same as Level I	Minimal, assuming proper treatment/ disposal of wastewater.
Compatibility with Existing Facilities	Compatible. Need only collection receptacle, hauler, and off-site landfill.	Same as Level I	Dewatering process usually requires minimal land requirement. Generally compatible. Secured landfill generally located off-site.

TABLE IV-3--Cont'd

Monitoring and Surveillance	None normally practiced.	Same as Level I	Wastewater monitoring required. Leachate monitoring may be required.
Installation Time	None required	Same as Level I	1-2 years for dewatering process.
Energy Requirements	For hauling waste to landfill site and covering with fill.	Same as Level I	Sludge dewatering equipment operation, hauling sludge to landfill site, and covering with fill. Possibly energy required for treatment of wastewater generated by sludge dewatering equipment.

TABLE IV-4

TREATMENT AND DISPOSAL OF ELECTROPLATING WASTES
(ACID AND ALKALINE)

FACTOR	Level I (Prevalent Technology)	LEVEL II (Best Technology Currently Employed)	LEVEL III (Technology for Adequate Health and Environmental Protection)
Physical & Chemical Properties of Residual Wastes	Water stream, possibly of an alkaline or acidic nature with heavy metal salts and possibly cyanides and fluorides.	Water stream of neutral pH	Water stream containing relatively large concentrations of heavy metals, fluorides, & cyanides.
Description of Residual Waste	Aqueous liquid	Same as Level I	Same as Level I
Factors Affecting Degree of	Heavy metal salts including chromium and zinc are toxic. Cyanides and fluorides which may be present are also toxic.	Same as Level I	Same as Level I
Treatment/Disposal Technology	Not currently disposed of on land	Neutralized on-site and sewered. Not currently disposed of on land.	Pending application of effluent guidelines; disposal of wastewater treatment residue in secured landfill.
Amount of potentially hazardous waste currently handled, kkg/yr wet weight	7,000	Same as Level I	0
Amount of residual waste, kkg/yr wet weight	0	0	Not applicable
Estimated number of plants using technology	80	Same as Level I	0
Estimated percentage of plants using technology	90	Same as Level I	0
Adequacy of Technology	Inadequate. Heavy metals, cyanides fluorides, alkalinity, and acidity can upset the operation of a biological sewage treatment plant.	Same as Level I	Adequate

TABLE IV-4 - Cont'd

Problems and Coments	Most inexpensive disposal method currently available.	Neutralization alone does not deal with the heavy metals, cyanide & fluoride problems.	Heavy metals removal from process wastewater will be relatively expensive. Manfacturer's ability to supply desalination equipment questionable.
Non-land Environmental Impact	Severe water pollution potential	Same as Level I	Mineral
Compatibility with Existing Facilities	Compatible. No special equipment required.	Compatible. Neutralization system has relatively small area requirements.	Probably compatible. Desalination equipment does not require substantial area.
Monitoring and Surveillance Techniques	None normally practiced	Effluent pH monitored	Treated wastewater must be monitored. Leachate should be monitored adjacent to site.
Installation Time	None required	Less than 1 year for neutralizing system.	Probably greater than 2 years for desalination equipment.
Energy Requirements	Usually none. Gravity sewers normally implemented.	Pumping through neutralizing facilities. Chemical feeding equipment.	Substantial energy required for desalination equipment.

TABLE IV-5
TREATMENT AND DISPOSAL OF HEAT TREATING WASTES

FACTOR	LEVEL I (Prevalent Technology)	LEVEL II (Best Technology Currently Employed)	LEVEL III (Technology for Adequate Health and Environmental Protection)
Physical & Chemical Properties	Dirty oil containing metal salts, cyanide salts, and sludge. Oil additives may contain hazardous constituents	Same as Level I	Same as Level I
Description of Residual Waste	Viscuous liquid with suspended solids.	Same as Level I	Same as Level I
Factors Affecting Degree of Hazard	Cyanides, heavy metal salts, and some oils are toxic.	Same as Level I	Same as Level I
Treatment/Disposal Technology	Off-site sanitary landfill	Same as Level I	Secured landfill. Rerefining of oils not contaminated with cyanide. Rerefining residue to secure landfill.
Amount of potentially hazardous waste currently handled, kkg/yr wet weight	10,000	Same as Level I	0
Amount of residual waste, kkg/yr wet weight	0	0	0
Estimated number of plants using technology	150	Same as Level I	0
Estimated percentage of plants using technology	75	Same as Level I	0
Adequacy of Technology	Inadequate. Runoff or leaching of oils, cyanides, or metals may occur, contaminating groundwater or surface water with toxic heavy metal salts cyanides and oil with attendant hazardous constituents	Same as Level I	Adequate, assuming no runoff or leachate.
Problems and Comments	Most inexpensive disposal method and readily available.	Same as Level I	Few secured landfills available at this time

TABLE IV-5 - Cont'd

Non-land Environmental Impact	Possible leachate and runoff problems.	Same as Level I	Minimal impact assuming no runoff or leachate.
Compatibility with Existing Facilities	Compatible. Need only collection receptacle, hauler, and off-site landfill.	Same as Level I	Same as Level I
Monitoring and Surveillance Techniques	None normally practiced	Same as Level I	Monitoring for existence of runoff and leachate adjacent to site advisable
Installation Time	None required	Same as Level I	1-2 years for secured landfill operations.
Energy Requirements	For hauling waste to landfill site and covering with fill.	Same as Level I	Same as Level I

TABLE IV-6
TREATMENT AND DISPOSAL OF PAINT WASTES

FACTOR	LEVEL I (Prevalent Technology)	LEVEL II (Best Technology Currently Employed)	LEVEL III (Technology for Adequate Health and Environmental Protection)
Physical & Chemical Properties of Residual Wastes	Mixture of pigment, resin, solvent, and possibly small concentration of additives. Some pigments, solvents, and/or additives are hazardous.	Incinerated ash consisting mainly of pigments-some of which are hazardous.	Same as Level II
Description of Residual Waste	Viscuous liquid	Dust	Same as Level II
Factors Affecting Degree of Hazard	Pigments of heavy metal salts and additives are toxic. Solvents may be flammable.	Dust contains pigments and additives which may be toxic.	Same as Level II
Treatment/Disposal Technology	Off-site sanitory landfill	Off-site incineration of paint sludge with ash to sanitary landfill. Separation and reclamation of solvents still buttons incineration followed by sanitary landfilling of ash	Incineration of paint sludge with ash to secured landfill. Separation and reclamation of solvents with still bottoms inclination followed by secured landfilling of ash
Amount of Potentially hazardous waste currently handled, kkg/yr wet weight	9,000	1,000	0
Amount of residental walk, kkg/yr wet weight	0	10	Not applicable
Estimated number of plants using technology	600	100	0
Estimated percent of plants using technology	75	10	0
Adequacy of Technology	Inadequate. Leaching of heavy metal pigment salts may occur, contaminating ground water or surface water with heavy metals	Inadequate. Leaching of heavy metal pigment salts from the ash may occur, contaminating groundwater or surface water with heavy metal.	Adequate, assuming proper air pollution control practiced for incinerator.

TABLE IV-6 - Cont'd.

Problems and Comments	Most inexpensive disposal method and readily available.	Insufficient number of incinerators and qualified operators available. Solvent reclaiming usually cost effective usually when utilizing a contractor	Same as Level II, plus current lack of secured landfills
Non-land Environmental Impact	Possible leachate and runoff problems.	Air pollution control may be a problem. Slight localized noise problem from incinerator.	Same as Level II
Compatibility with Existing Facilities	Easily compatible. Need only collection receptacle, hauler, and off-site landfill operation.	Compatible. Ideally, incinerator should be located adjacent to landfill site.	Same as Level II
Monitoring and Surveillance Techniques	None normally practiced	None normally practiced	Leachate, runoff, and incinerator stack gas monitoring
Installation Time	None required	Incinerator could take 1-1/2 - 3 years from design to startup	Same as Level II
Energy Requirements	For hauling waste to disposal site and covering with fill.	For hauling waste to disposal site; supplemental fuel for incinerator; transferring ash to landfill; covering ash with fill.	Same as Level II

waste reduction technique available universally. Larger plants also have the option to install automatic detection devices, particularly where solutions of highly toxic metals are employed.

The substitution of equally efficient nontoxic materials for the toxic ones of historic use appears to require more development before it becomes a viable waste control technique. However, some beginning is evident in the use of noncyanide plating solutions and heat treating salt baths as well as in the stated desire of plant management to reduce the amounts of cyanides employed. This is similarly evident to the trend to nontoxic types of paint.

A number of alternatives for controlling drag-out have been advanced. These include reducing the viscosity of the plating bath through the use of chemicals of lower density and increasing process temperature [57], slower removal of the workpiece form the bath and longer drain times, and neutralization of the thin films of toxic chemicals clinging to the work piece before it is rinsed in water [58].

Other waste load improvements are seen in closer control of process solution concentrations and in various means of reducing volumes of water used in contact with toxic materials [57]. Another development which is beginning to find use is selective plating. In this technique, areas where plating is unnecessary are masked, and only the significant surface areas are treated, thus reducing quantities of metal solutions needed. The economics of employing more environmentally acceptable treatment and land disposal techniques may serve as the impetus for the development and wider application of these and other waste reducing measures.

SECTION V

COST ANALYSIS

INTRODUCTION

Potentially hazardous waste treatment and disposal costs for typical plants are supplied in this section. A discussion of treatment and disposal costs is then provided, organized according to the three levels of technology as described in Section IV. Level I technology for the four potentially hazardous wastes of the special industrial machinery and office, computing, and accounting machines industries is discussed first. This is followed by an analysis of Level II, and finally Level III. A summary table showing treatment and disposal costs for each major waste at each technology is provided at the end of the section.

Approximations of the effects of these treatment and disposal costs at the various technology levels are supplied. Annual costs to the industries as a whole are given and compared with other economic indicators such as value of shipments, value added by manufacture, and cost of materials. The data are presented in terms of 1975 dollars.

Cost data on current waste treatment and disposal practices in the subject industries were sparse at most of the plants visited and much of the information collected is in the form of estimates by plant personnel. Nonetheless, it was necessary to use these data as a basis for the cost analysis of Level I and II technology. Supplemental information was provided from a study of hazardous waste treatment and disposal cost variability [63] and from a recent study on the potential for capacity creation in the hazardous waste management service industry [64]. Data were also compiled from the literature and from contacts with four waste disposal operations specifically handling wastes from these industries.

Level III technology is not being implemented by the subject industries. Cost estimates for this technology as it applies to the various waste streams were developed from the literature sources referenced in this section.

A key feature of the following cost analyses is that the costs given for each level of technology are based on off-site waste treatment and disposal. The reasons for this are as follows:

1. At least 90 percent of all special industrial and office machines manufacturers dispose of their process wastes off-site.

2. The majority of existing plants are located in urban areas where space availability for treatment and disposal facilities

on-site would be a major problem.

3. For the vast majority of establishments, most types of potentially hazardous wastes are generated in such relatively small quantities that on-site treatment and/or disposal would be economically unattractive compared with off-site alternatives — even those comprising Levels II and III technology.

TREATMENT AND DISPOSAL COSTS AT TYPICAL MANUFACTURING PLANTS

A typical manufacturing establishment in SIC 355 was defined in Section III as a machine shop with attendant plate or structural fabrication areas and a small painting operation. Production employees in these specific areas, but not including receiving and shipping and other staff or maintenance areas, totalled seventeen. As shown in Table V-1, process wastes consisting of coolants and oils, sweepings and grindings, solvents, and paint sludge and overspray were generated at a rate of approximately 16.4 kkg/year (18.1 tons/year) on a wet weight basis. All these wastes are considered potentially hazardous based on the criteria used by the contractor.

Section IV stated that all the process wastes from the typical plant are picked up by a private hauler periodically and taken to a sanitary landfill operation for disposal. This constitutes Level I technology. The cost of this service is roughly $287/year. Average treatment and disposal costs for Level I technology are $18/kkg ($16/ton) on a wet basis and $27/kkg ($25/ton) on a dry basis, as shown in Table V-1. To achieve environmentally adequate treatment and disposal (Level III), costs would increase by about 21 percent.

If Level II technology were practiced by the plant, treatment and disposal costs would run approximately $344/year, mainly as a result of sending waste solvent to a contractor's reclaiming operation instead of to a landfill site. The average cost is $21/kkg ($19/ton) on a wet basis and $32/kkg ($29/ton) on a dry basis.

The implementation of Level III technology would increase the treatment and disposal costs slightly for potentially hazardous wastes. These would total about $347/year. The cost increase is mainly due to the added cost of placing certain wastes, sludges, and ashes in secured land disposal sites rather than in sanitary landfills. Wet weight and dry weight treatment and disposal costs are $21/kkg ($19/ton) and $32/kkg ($29/ton), respectively.

A summary of the costs for each technology level is shown in Table V-1.

TABLE V-1

Typical Plant Costs for Treatment and Disposal of Potentially Hazardous Wastes, 1975 (SIC 355)

Typical Plant Characteristics

The typical plant has 17 employees and in located in an urban area in EPA Region V. The manufacturing processes are: Machine Shop, Plate & Structural Fabrication, and Paint Shop. The composition of waste derived from these processes are: dirty oil; waste solvents; sweepings and grindings. Annual waste generation rates in kkg/product, employee are 1.0 (wet) and 0.6 (dry) for Machine Shop and Plate and Structural Fabrication combined and 1.0 (wet) and 0.8 (dry) for Paint Shop Waste.

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost, $	287	344	347
Cost/kkg of Waste (1) (wet) $	18	21	21
Cost/kkg of Waste (1) (dry) $	27	32	32
Cost/yr-Production Emp., $	17	20	20

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling of all process wastes by private contractor.
Level II: (2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a sanitary landfill. Off-site sanitary landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a sanitary landfill. Incineration of paint wastes by a private contractor with ash disposal in sanitary landfills.
Level II: (2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a secured landfill. Off-site secured landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a secured landfill. Incineration of paint wastes by a private contractor with ash disposal in a secured landfill.

Notes: (1) Total porcess waste = total potentially hazardous wastes.
(2) Waste segregation necessary.

Source: Contractor estimates.

Office, Computing, and Accounting Machines Industry

A typical manufacturing plant producing office, computing, and accounting machines (SIC 357) was defined in Section III as a facility basically consisting of a machine shop and an assembly operation. Process wastes are accumulated at a total rate of 14.4 kkg/year (15.9 tons/year) on a wet weight basis and 9.3 kkg/yr (10.3 tons/yr) on a dry basis. These wastes are considered potentially hazardous by the contractor based on the criteria proposed in Section III. As with the typical plant in SIC 355, these materials are collected by a private contractor according to a set time schedule — usually between once per week and once per month. As shown in Table V-2, for Level I (most prevalent technology), these wastes are hauled to a landfill operation. This costs the typical plant approximately $260/year. The average treatment and disposal costs are $18/kkg ($16/ton) on a wet basis and $28/kkg ($25/ton) on a dry basis.

If Level II technology were implemented, the total potentially hazardous waste treatment and disposal cost would be about $274/year, or $19/kkg ($17/ton) and $29/kkg ($26/ton) on wet and dry bases, respectively.

Level III technology for the plant would cost about the same as Level II, with the disposal of residues taking place in secured landfills instead of in sanitary landfills.

These costs are summarized in Table V-2.

TREATMENT AND DISPOSAL COSTS

Level I Technology

Level I technology is defined by EPA as the most prevalent technology currently employed — i.e., the broad average present treatment and disposal practice. The costs of handling, treating, and disposing of each potentially hazardous waste of the subject industries are discussed below.

Machine Shop Wastes

Level I technology for machine shop wastes consists of off-site disposal in a sanitary landfill by a private contractor. As detailed in Table V-3, the cost of this practice is $18/kkg ($16/ton) on a wet basis. The accuracy of this figure is on the order of ± 30 percent.

TABLE V-2

Typical Plant Costs for Treatment and Disposal of Potentially Hazardous Wastes, 1975 (SIC 357)

Typical Plant Characteristics

The typical plant has 15 employees and is located in an urban area in EPA Region IX. The manufacturing process is Machine Shop (with assembly). The composition of waste derived from this process is dirty oil; waste solvents; sweepings & grindings. Annual waste generation rates in kkg/product. employee is are (wet) and 0.6 (dry).

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost, $	260	274	274
Cost/kkg of waste (1) (wet) $	18	19	19
Cost/kkg of waste (1) (dry) $	28	29	29
Cost/yr-Production Emp., $	17	18	18

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling of all process wastes by private contractor.
Level II:(2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a sanitary landfill. Off-site sanitary landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a sanitary landfill.
Level II:(2)	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a secured landfill. Off-site secured landfilling of remaining machine shop wastes. Reclamation of solvents off-site with still bottoms incineration followed by ash disposal in a secured landfill.

Notes: (1) Total process waste = total potentially hazardous waste.
(2) Waste segregation necessary.

Source: Contractor estimates.

TABLE V-3

Treatment and Disposal Costs for Machine Shop Wastes in SIC 355 & 357

Typical Plant Characteristics

The typical plant has 16 employees and is located in an urban area in EPA Region V. The composition of waste derived from this process are: coolants; sweepings and grindings; solvents. Annual waste generation rates in kkg/product, employee are: coolants - 1.29 (wet) 0.51 (dry), sweepings and grindings 1/25 (wet) 1.00 (dry), and solvents - 0.81 (wet), 0.50 (dry).

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost, $	965	1018	1018
Cost/kkg of Waste (wet) $	18	19	19
Cost/kkg of Waste (dry) $	28	30	30
Cost/yr-Production Employee $	60	63	63

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling of all process wastes by private contractor.
Level II:	Off-site recovery of waste oils through rerefining with residues of the rerefining operation going to a sanitary landfill. Off-site recovery of waste solvents through reclaiming with incineration of still bottoms and sanitary landfilling of resultant ash. Off-site sanitary landfilling of sweepings and grindings.
Level III:	Same as Level II, except secured landfills are used in place of sanitary landfills.

Source: Contractor estimates.

Electroplating Wastes

Electroplating wastes of the subject industries are predominantly hauled by private contractors to off-site sanitary landfills for disposal as shown in Table V-4. These wastes consist of heavy metal sludges. The cost of this practice is $16/kkg ($15/ton) on a wet basis and $40/kkg ($38/ton) on a dry weight basis.

The principal process waste from electroplating operations is acid/alkali rinse waters which are not currently disposed of on land. Although they are presently sewered, pending effluent guidelines will mean that by 1983, waste sludges from the treatment of acid/alkali wastes will be generated and will require some form of soid waste treatment and disposal. No Level I or Level II costs for acid/alkali waste treatment are stated in this report since the materials are not handled as solid wastes. It should also be noted that the quantities of acid/alkaki wastes that are currently generated and which will be generated in 1977 have not been included in the process waste generation tables presented in Section III and in Appendices I and J.

Heat Treating Wastes

These wastes are currently hauled to off-site sanitary landfills by private contractors. This constitutes Level I technology. The costs of this practice is approximately $24/kkg ($22/ton) and $59/kkg ($54/ton) on wet weight and dry weight bases, respectively as shown on Table V-5. Typical of the cost data in this section, these estimates are probably accurate to ± 30 percent.

Paint Shop Wastes

Level I technology for paint shop wastes consists of discarding the combined paint sludge and solvent in off-site sanitary landfills. This costs $10/kkg ($9/ton) on a wet basis and $13/kkg ($12/ton) on a dry basis. These costs, along with a description of a typical paint shop, are shown in Table V-6.

Level II Technology

Level II potentially hazardous waste treatment and disposal technology is defined as the best technology currently employed as found through site surveys or in the literature. Identified technology at this level must represent the soundest process from an environmental and health standpoint currently in use in at least one manufacturing location.

TABLE V-4

Treatment and Disposal Costs for Electroplating Wastes in SIC 355 & 357

Typical Plant Characteristics

The typical plant has 44 employees and is located in an urban area in EPA Region V. Annual waste generation rates in kkg/product, employee for each waste constituent are: heavy metal sludge 1.88 (wet, 0.44 (dry); solvents 0.64 (wet) 0.44 (dry); acids/alkalies(1) 1.00 (wet), 0.12 (dry).

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost $	40	40	208
Cost/kkg of Waste (wet) $	16	16	59
Cost/kkg of Waste (dry) $	40	40	148
Cost/yr-Production Employee $	1	1	3

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling of all process wastes by private contractor.
Level II:	Same as Level I. Solvents to reclaiming with still bottoms to off-site sanitary landfill.
Level III:	Sludge dewatering followed by secured landfilling. Solvent reclaiming with still bottoms to off-site secured landfill. Sludge from acid/alkali wastewater treatment to secured landfill.

Notes: (1) Acid/alkali residues will be generated by 1983 pending the impletation of effluent guidelines.

Source: Contractor estimates.

Table V-5

Treatment and Disposal Costs for Heat Treating Wastes in SIC 355 & 357

Typical Plant Characteristics

The typical plant has 26 employees and is located in an urban area in EPA Region V. Annual waste generation rates in kkg/product, employee for each waste constituent are: quench oils 0.85 (wet), 0.65 (dry); cyanide salts 0.14 (wet), 0.14 (dry); acids/alkalies 1.00 (wet), 0.12 (dry).

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost $	1248	1248	3120
Cost/kkg of Waste (wet) $	24	24	60
Cost/kkg of Waste (dry) $	59	59	146
Cost/yr-Production Employee $	48	48	120

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling of all process wastes by private contractor.
Level II:	Same as Level I.
Level III:	Secured landfill for all wastes contaminated with cyanides. Reclamation of noncontaminated oils with rerefining residues to secured landfill.

Source: Contractor estimates.

Table V-6

Treatment and Disposal Costs for Paint Wastes in SIC 355 & 357

Typical Plant Characteristics

The typical plant has 14 employees and is located in an urban area in EPA Revion V. Annual waste generation rates in kkg/product employee for each waste constituent are: paint sludge 0.55 (wet), .43 (dry) and solvents 0.50 (wet), .38 (dry)

Treatment/Disposal Costs	Level I	Level II	Level III
Total Annual Cost $	147	750	794
Cost/kkg of Waste (wet) $	10	51	54
Cost/kkg of Waste (dry) $	13	67	71
Cost/yr-Production Employee $	10	54	57

Description of Treatment/Disposal Technology

Level I:	Off-site sanitary landfilling by a private contractor.
Level II:	Off-site incineration of paint sludge with ash to sanitary landfill. Separation and reclamation of solvents with still bottoms incineration followed by sanitary landfilling of ash.
Level III:	Same as Level II except secured landfills are used in place of sanitary landfills.

Source: Contractor estimates.

Machine Shop Wastes

Level II technology for machine shop wastes, as shown in Table V-3, involves segregation of oils and solvents from other waste constituents. The rerefining of waste oil off-site by a private contractor has been determined to be part of Level II technology. Residues from the rerefining operations are placed in sanitary landfills.

Solvents are reclaimed off-site with still bottoms from the reclaiming operation being incinerated and residual ash going to a sanitary landfill. Remaining machine shop wastes are sanitary landfilled by a private contractor off-site.

This practice costs about \$19/kkg (\$17/ton) on a wet weight basis and \$30/kkg (\$27/ton) on a dry weight basis. However, costs for Level II can vary over a wide range. For example, waste oil rerefining costs will vary depending on the amount of "Dirt" it contains. Prices quoted for small lots of waste oil by a Midwestern rerefining contractor are as follows:

"Dirt" Concentration in Oil	Price Range ¢/liter	Price Range ¢/gal.
> 15%	0-1	1-5
11-14%	0	0
< 10%	[0-2]	[1-7]

(Dirt concentrations are determined mainly by visusal means)

The contractor will pay up to 2¢/liter (7¢/gallon) for relatively clean oil which can be more easily rerefined. On the other hand, some of the dirtier oils obtained may be used for road oiling instead of rerefining. Another contractor charges \$22/kkg (\$20/ton) for waste oil, which is sold in turn to rerefining operations.

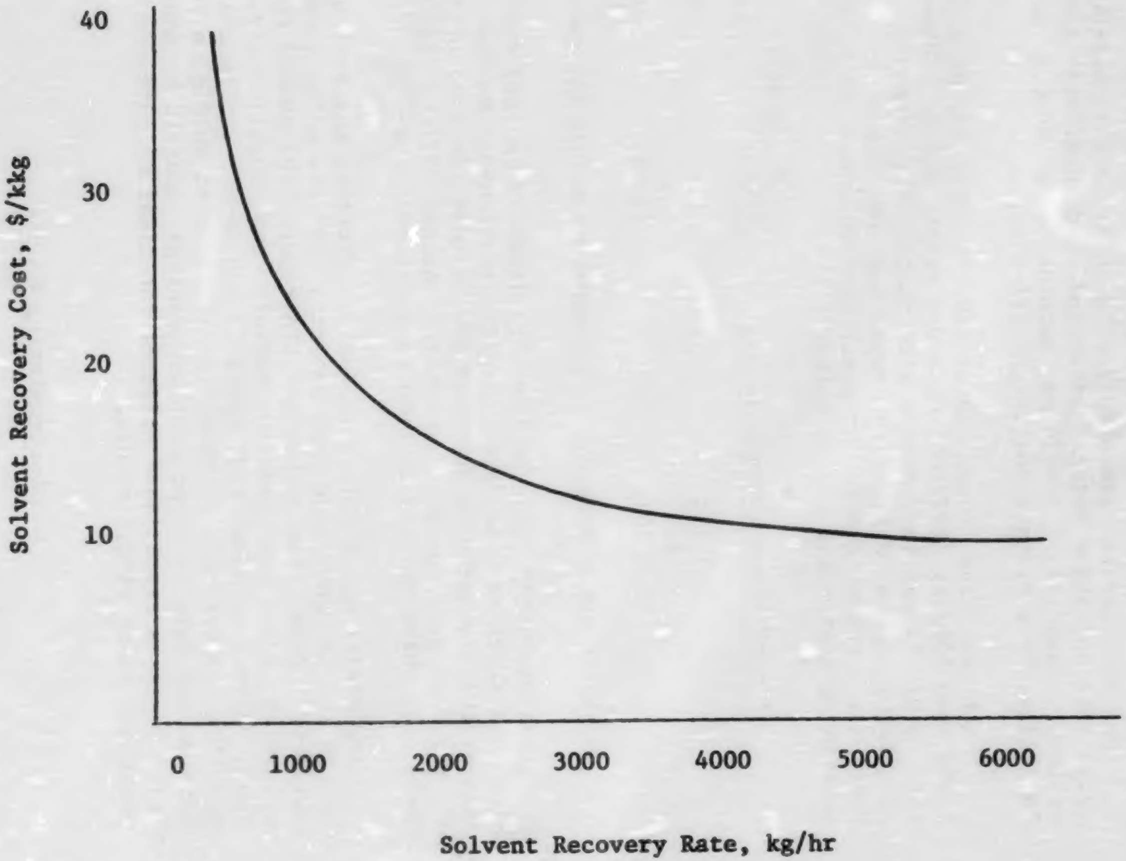
In addition, a principal factor affecting the cost of solvent reclaiming is the size or capacity of the solvent reprocessing facility. Date from an earlier EPA report [60] showed that solvent reclaiming costs are reduced rapidly and continuously up to a capacity level of about 1500 kg/hr (3,300 lbs/hr). The costs decline much slower after this. This is illustrated in Figure V-1. These costs do not take into account any savings incurred by manufacturing plants in using reprocessed solvents for cleaning purposes instead of buying and using virgin stocks.

Electroplating Wastes

Level II technology is the same as Level I, consisting of off-site disposal in a sanitary landfill. This service, rendered by

FIGURE V-1

SOLVENT RECOVERY COST DEPENDENCE ON RECOVERY RATE



a private contractor, costs $16/kkg ($15/ton) and $40/kkg ($38/ton) on wet and dry weight bases, respectively. Charges for sewered alkali/acid wastes are not included in these figures, as indicated in Table V-4.

Heat Treating Wastes

Level II treatment and disposal technology for this waste is equivalent to Level I at $24/kkg ($22/ton) on a wet basis and $59/kkg ($54/ton) on a dry basis.

Paint Shop Wastes

Painting operations wastes from SIC 355 and 357 plants are sometimes incinerated at an off-site contractor's facilities with the ash transported to a sanitary landfill. In addition, solvents are reclaimed, with still bottoms incinerated. Ash is deposited in sanitary landfills. This comprises Level II technology for paint wastes as documented in Table V-6.

The average wet weight cost is $51/kkg (46/ton).

Two of the major factors affecting the cost of this treatment and disposal technology are (1) size of the incineration operation, and (2) the type of incinerator used. Although the first point cannot be quantitatively discussed using available data, it was found that relatively large contract incineration installations serving a number of clients could afford to charge less than smaller incinerator installations. This is consistent with standard cost-capacity engineering concepts.

Level III Technology

Level III technology is defined as the treatment and disposal technology necessary to provide adequate health and environmental protection. Level III technology may be more or less sophisticated or may be identical to Level I or Level II technology. At this level, identified technology may include pilot or bench scale processes, providing the exact stage of development can be identified.

Machine Shop Wastes

Level III technology is the same as Level II except that secured landfills are utilized for residue disposal instead of sanitary landfills. This does not increase the estimated cost of treatment and disposal for Level II values which are $19/kkg ($17/ton) on a wet basis.

Electroplating Wastes

Sludge dewatering followed by disposal in a secured landfill is Level III technology for heavy metal sludge. In addition, sludge from acid/alkaline wastewater treatment facilities are deposited in secured landfills. This practice will cost a total of $59/kkg ($54/ton) on a wet basis. Of this, $11/kkg ($10/ton) is due to acid/alkaline waste disposal.

Heat Treating Wastes

Level III for this waste consists of secured landfilling which costs $60/kkg ($54/ton) on a wet weight basis and $146/kkg ($132/ton) on a dry weight basis.

Paint Shop Wastes

Incineration of paint sludge followed by ash disposal in a secured landfill constitutes Level III treatment and disposal technology along with solvent segregation, reprocessing, still bottoms incineration, and subsequent ash disposal in a secured landfill. These practices cost $54/kkg ($49/ton).

Potentially hazardous waste treatment and disposal costs are summarized in Table V-7.

IMPACT OF POTENTIALLY HAZARDOUS WASTE MANAGEMENT UPON THE INDUSTRIES

The total costs to treat and dispose of potentially hazardous wastes in the special industrial machinery and office, computing, and accounting machines industry for each of the three levels of technology are shown in Table V-8.

The cost of Level I technology for all potentially hazardous wastes generated at 1975 rates (excluding all nonhazardous process wastes and nonprocess wastes such as garbage) is roughly $2.8 million per year. Nationwide, implementation of Level II technology would cost approximately $3.5 million. This increase is primarily due to the additional costs involved to incinerate paint sludge wastes and to reclaim spent solvents. No credit has been allowed for reusing reprocessed oils and solvents. It has been assumed that all these materials can be reprocessed, which in practice is not entirely true. For example, solvents used to clean electronic components in office machines are sent to solvent reclaimers after their initial use and are not purchased back. Only virgin solvent with high quality

Table V-7

Potentially Hazardous Waste Treatment and Disposal Costs

Process	Cost, \$/kkg (\$/ton)(2)					
	Level I		Level II		Level III	
	Wet	Dry	Wet	Dry	Wet	Dry
Machine Shop(1)	18 (16)	28 (25)	19 (17)	30 (27)	19 (17)	30 (27)
Electroplating:						
Heavy Metal Sludges	16 (15)	40 (38)	16 (15)	40 (38)	48 (44)	120 (110)
Acid/Aklali	NA NA		NA NA		NA NA	
Heat Treating	24 (22)	59 (54)	24 (22)	59 (54)	60 (54)	146 (132)
Paint Shop	10 (9)	13 (12)	51 (46)	67 (61)	54 (49)	71 (64)

Notes (1) Includes wastes from tool and die shops; stamping, blanking, and forming operations; and plate and structural fabrication operations.

(2) The wet and dry weight factors used in deriving these waste T/D costs are approximate and may vary with given manufacturing operations.

Source: Contractor estimates.

Table V-8

Total National Costs to the SIC 355 and 357 Industries for Potentially Hazardous Waste Treatment and Disposal (1975)

Process	Cost, $ thousand/year Level I	Level II	Level III
Machine Shop	2,124	2,224	2,242
Electroplating			
Heavy Metal Sludges	206	206	617
Acid/Aklali	---	---	141
Heat Treating	348	348	870
Paint Shop	135	688	729
Total	2,813	3,484	4,599

specifications is used. As another example, a reprocessed oil may not be suitable for the same high-temperature and high-corrosion service for which the original oil was used.

Level III technology use will cost the SIC 355 and SIC 357 industries roughly $4.6 million, a 63 percent increase over the currently used practices. The utilization of secured landfilling operations is an important factor which serves to establish Level III costs.

These total national costs have been compared to the value added by manufacture, the cost of materials, and the value of shipments in 1972 for SIC 355 and 357 combined. The results are shown in Table V-9. The current cost for implementation of Level I technology constitutes only 0.02 percent of the total value of shipments which was $14.8 billion according to the 1972 Census of Manufactures [5]. Industry-wide implementation of Level II technology would not significantly affect the fraction of value of shipments, and the implementation of Level III technology would only increase the cost ratio to 0.03 percent. This shows that the impact of potentially hazardous waste treatment and disposal costs are minimal on the industry as a whole.

Table V-9

Comparison of Technology Costs to SIC 355 and 357 Industry Characteristics

	Technology Costs as a Percent of the Industry Characteristic		
Industry Characteristics	**Level I**	**Level II**	**Level III**
Value Added by Manufacture ($8.5 billion/yr)	**0.03**	**0.04**	**0.05**
Cost of Materials ($6.3 billion/yr)	**0.04**	**0.06**	**0.07**
Value of Shipments ($14.8 billion/yr)	**0.02**	**0.02**	**0.03**

SECTION VI

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SECTION VII

GLOSSARY

Acute Toxicity

Any poisonous effect produced within a short period of time, usually up to 24-96 hours, resulting in severe biological harm and often death.

Adsorption

The adhesion of a substance to the surface of a solid or liquid. Adsorption is often used to extract pollutants by causing them to be attached to such adsorbents as activated carbon or silica gel. Hydrophobic, or water-repulsing adsorbents, are used to extract oil from waterways in oil spills.

Annealing

A metalworking operation which reduces hardness, improves machinability, facilitates cold working, and produces a desired microstructure. Annealing is accomplished by heating a metal above a temperature which changes its microstructure and then slowly cooling it down.

Aquifer

An underground bed or stratum of earth, gravel or porous stone that contains water.

Arc Furnace

A furnace in which material is heated either directly by an electric arc between an electrode and the material or indirectly by an arc between two electrodes adjacent to the material.

Arc Welding

Welding with an electric arc.

Assembly of Product

The process of bringing together and attaching individual pieces and units to form a completed product.

Baghouse

An air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags, usually made of glass fibers.

Preceding page blank

Biodegradable

The process of decomposing quickly as a result of the action of microorganisms.

Blanking

A process accomplished with dies in presses in which desired shapes are cut from flat or performed stock.

Carburizing

A metalworking operation in which carbon is introduced into the surface of low carbon steels by heating them in carbon-rich media followed by quenching.

Carcinogen

A chemical which produces or incites cancer.

Charge

The liquid and solid materials fed into a furnace during one casting cycle.

Chlorinated Hydrocarbons

A class of generally long-lasting, broad-spectrum insecticides of which the best known is DDT, first used for insect control during World War II. Other similar compounds include aldrin, dieldrin, heptachlor, chlordane, lindane, endrin, mirex, benzene hexachloride (BHC), and toxaphene. The qualities of persistence and effectiveness against a wide variety of insect pests were long regarded as highly desirable in agriculture, public health and home uses. But later research has revealed that these same qualities may represent a potential hazard through accumulation in the food chain and persistence in the environment.

Clarifier

In waste water treatment, a settling tank which mechanically removed settleable solids from wastes.

Coining

A closed-die squeezing operation, usually performed cold, in which all surfaces of the work are confined or restrained, resulting in a well-defined imprint of the die upon the work.

Cover Material

Soil that is used to cover compacted solid waste in a sanitary landfill.

Cupola

A cylindrical vertical furnace for melting metal, especially gray iron, by having the charge come in contact with the hot fuels, usually metallurgical coke.

Dermal Toxicity

The ability of a chemcial to poison an animal or human by skin absorption.

Drag-out

The amount of bath solution from an electroplating operation or a molten salt heat treating operation carried out of the bath by the material being treated or the rack holding the material.

Drawing

Forming recessed parts by forcing the plastic flow of metal in dies; reducing the cross section of wire or tubing by pulling it through a die.

Dump

A land site where solid waste is disposed of in a manner that does not protect the environment.

Dust

Fine-grain particulate matter that is capable of being suspended in air.

Ecology

The interrelationships of living things to one another and to their environment or the study of such relationships.

Electroplating

Electrodisposition of a metal or alloy from a suitable electrolyte solution: the article to be plated is connected as the cathode in the electrolyte solution; direct current is introduced through the anode which consists of the metal to be deposited.

Electrostatic Precipitator

An air pollution control device that removes particulate matter by imparting an electrical charge to particulates in a gas stream for mechanical collection on an electrode.

Electrostatic Spray Painting

A coating application technique in which the spray nozzle is charged with work surface. Very high voltage at low amperage is used. Spray particles are attracted to the work by the opposite charge, to the extent that some of the overspray curves back and coats the reverse side of the work. Very largely used for the application of powder coatings.

Environment

An organic coating which has a gloss like glass.

Etching

The sum of all external conditions and influences affecting the life, development and survival of an organism.

Treating the surface of a metal to preferential chemical or electrolytic attack in order to reveal structural details.

Facing

Milling a surface that is perpendicular to the cutter axis.

Ferrous Foundry

A commercial establishment which produces castings in which the predominant metal is iron.

Flash Point

The temperature at which a liquid gives off vapor sufficient to form an ignitable mixture with the air contained in the vessel used.

Flux

A material used to combine with and remove undesirable substances such as sand or iron oxides from molten metal or to provide a protective covering for certain molten metal baths.

Forming

Plastic deforming material, usually hot, into desired shapes with compressive force, with or without dies.

Forming

An operation which shapes metal by deformation.

Foundry Pattern Shop

An establishment, often part of a foundry, which produces forms of wood, metal, or other materails around which modling material such as sand is placed to make a mold for the casting of metals.

Galvanizing

The application of a zinc coating to steel to provide protection against corrosion.

Gates

Scrap metal on casting surfaces created by a channel through which molten metal enters the mold.

Hardness

Resistance to penetration.

Heat Treating of Metals

Heating and cooling of metals or alloys to obtain desired properties or conditions.

Heavy Metals

Metallic elements with high molecular weights, generally toxic in low concentrations to plant and animal life. Such metals are often residual in the environment and exhibit biological accumulation. Examples include mercury, chromium, cadmium, arsenic, and lead.

Incineration

The controlled process by which solid, liquid or gaseous combustible wastes are burned and changed into gases; the residue produced contains little or no combustible material.

Incinerator

An engineered apparatus used to burn waste substances and in which all the combustion factors — temperatures, retention time, turbulence and combustion air — can be controlled.

Inhibition

The action of chemicals where the total effect is less than the sum of two or more effects taken independently.

Inoculant

Material added to a molten metal to aid crystallization.

Induction Furnace

An electric furnace in which the primary conductor is coiled and generates, by electromagnetic induction, a secondary current which develops heat within the metal charge.

LC$_{50}$

Median lethal concentration, a standard measure of toxicity. LC50indicates the concentration of a substance that will kill 50 percent of a group of experimental insects or animals.

Leachate

Liquid that has percolated through solid waste or other mediums and has extracted dissolved or suspended materials from it.

Leaching

The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

Machine Shop

A workshop in which work, metal or other material, is machined to specified size. Machining is the process of removing material from the item in the form of chips through the use of a machine and cutting tools.

Maintenance

The function responsible for the upkeep of facilities and equipment.

Metal

Any of a large group of substances (such as steel, iron, or bronze) that typically show a characteristic luster, are good conductors of electricity and heat, or opaque, can be fused, and are usually malleable or ductile.

Milling Machine

A rotary cutting tool provided with one or more cutting elements, called teeth, which intermittently engage the workpiece and remove material by relative movement of the workpiece and cutter.

Moisture Content

The weight loss (expressed in percent) when a sample of material is dried to a constant weight at a temperature of 105°C.

Mold

A shaped cavity for casting.

Mutagen

A chemical which can cause a permanent change in hereditary materail involveing a physical change in chromosome relations or a biochemical change in the codons (a triplet of nucleotides that is part of the genetic code and that specifies a particular amino acid in a protein or stops or starts protein synthesis) that makes up genes.

N.E.C

Also written as n.e.c. - Not elsewhere classified.

Nonferrous Die Casting

The forming of castings in dies, as opposed to foundry molds, of metals other than iron and its alloys.

Nonferrous Foundry

A commercial establishment which produces castings of metals other than iron and its alloys.

Normalizing

A term usually applied to ferrous alloys, involving heating the work piece to a suitable temperature above the transformation range and then cooling it in air to a temperature substantially below the transformation range

Nitriding

Introduction of nitrogen to the surface of a steel to change the surface properties.

N.S.K.

Not specified by kind.

Oil

An organic substance, or class of substances, usually insoluble with water.

Open-Hearth Furnace

A reverberatory melting furnace with a shallow hearth and a low roof. The flame passes over the charge on the hearth, causing the charge to be heated both by direct flame and by radiation from the roof and sidewalls of the furnace.

Organic Solvent

A carbon-based liquid or class of liquids, used in the special machines manufacturing industry to remove oil, grease, and dirt from metal work.

Organism

Any living human, plant, or animal.

Painting, Lacquering, Enameling on Metals

The process of applying an organic coating on metal surfaces.

pH

A measure of the acidity or alkalinity of a material; pH is represented on a scale of 0 to 14 with 7 representing a neutral state, 0 representing the most acid and 14, the most alkaline.

Pickling

Removing surface oxides from metals by chemical or electrochemical reaction.

Plastics Molding

The process of forming shapes of plastic materials using dies.

Plate or Structural Fabrication

The production of products made of steel plates and other steel structural shapes such as sheet, angles, channels, I-beams. Processes involved include shearing, gas-cutting, punching, forming, welding, riveting.

Pollutant

Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

Pollution

The presence of matter or energy whose nature, location or quantity produces undesirable environmental effects.

Pollution Abatement

The method of reducing the degree or intensity of pollution, including the use of such a method.

Potentially Hazardous Waste

Any waste or combination of wastes which pose a substantial present or potential hazard to human health or living organisms because such wastes are lethal, nondegradable, or persistent in nature; may be biologically magnified; or may otherwise cause or tend to cause detrimental cumulative effects.

Press Brake

An open-frame single-action press used to bend, blank, corrugate, curl, notch, perforate, pierce, or punch sheet metal or plate.

Printed Circuit Board

The board in electronic equipment which provides a base for point-to-point wiring of components. A conductive substance, frequently copper, is applied to a synthetic base such as epoxy or bakelite and a pattern is then etched or photographically printed on the surface to provide a wiring grid.

Process

An integral part of special machinery manufacturing operations. Processes include casting, forging, electroplating, heat treating, machining, coating, plastics molding and assembly. In the context of this report, a process is the basic source of manufacturing wastes and is used as the common unit for quantifying wastes collectively on state, regional, and national bases.

Process Waste

Residual material emanating directly from manufacturing processes which may contain oil, solvents, acids and alkalies, metal and metallic compounds, and paint, among other constituents.

Process Waste Stream

Used synonymously with the terms "waste" and "process waste."

Reverberatory Furnace

A furnace with a shallow hearth with a roof which deflects the flame and radiates heat toward the hearth or the surface of the charge.

Riser

Excess metal on a casting created by a reservoir of molten metal to provide additional metal to the casting as required before and during solidification.

Sanitary Landfilling

A method of waste disposal on land in a manner that protects the environment; waste is spread in thin layers, compacted to the smallest practical volume and covered with soil at the end of each working day.

Scrubber

An air pollution control device that uses a liquid spray to remove pollutants from a gas stream by absorption or chemical reaction. Scrubbers also reduce the temperature of the emission.

Secured Landfill

Land disposal facilities characterized by inpervious contaminant of wastes with provisions for monitoring and treating leachate if required.

Shaw Process

A heat process used to prepare two types of ceramic molds for castings. One is a one-piece all ceramic mold; the other is a less expensive composite mold consisting of a layer of fericlay back up material with a thin ceramic facing.

Shipping Including Pack and Crate

The process of preparing product for shipment to purchaser through use of various packing materials or wood crates, and physically loading product into trucks or railroad cars.

Sludge

A semi-solid and generally viscuous material.

Spot Welding

Welding, generally resistance welding of lapped parts, in which fusion is confined to a relatively small circular area.

Sprues

Scrap metal on casting surfaces created in the shape of a channel through which molten metal is poured.

Stamping, Blanking, and Forming of Metals

Stamping and blanking involve the use of presses and dies to remove various shapes from metal sheets or plates; forming involves the use of presses and dies to change the shape or contour of a metal part without intentionally altering the thickness.

Swarf

Metal grindings and floor sweepings.

Synergism

A cooperative action of chemicals so that the total effect is greater than the sum of two or more effects taken independently.

Teratogen

A chemical which can cause malformations, monstrosities, or serious deviations from the normal type in organisms.

Thermoplastic Resin

A polymeric material that softens with increased temperature. Examples are cellulose acetate and polyethylene.

Thermosetting Resin

A polymeric material which does not soften, but rather polymerizes further with increasing temperature such as phenolic resins.

Toxic Substance

Chemicals considered dangerous to health and the environment, such as phenols, arsenic, and cyanides.

Turning

Removing metal from a rotating workpiece by means of a tool.

Vacuum

Condensation of thin metal coatings on the cool surface of a metal piece in a vacuum.

Waste Constituent

A component of a waste such as oil, solvent, paint, metal and metallic compounds, acid and alkalies, among others. Constituents may also include heavy metal salts, cyanide salts, etc.

Welding

Joining two or more pieces of material by applying heat, pressures, or both, with or without filler material to produce a localized union through fusion or recrystallization across the interface.

Workpiece

Usually a metal part subjected to machining or surface treatment.

APPENDIX A

SIC 355 - SPECIAL INDUSTRY MACHINERY, EXCEPT METALWORKING MACHINERY

PRODUCTS PRODUCED

SIC Code	Industries and Products
3551- --	FOOD PRODUCTS MACHINERY
35511 --	Dairy and Milk Products Plant Machinery and Equipment, Except Bottling and Packaging Machinery
35511 15	Washing and sterilizing equipment
35511 43	Pasteurizers
35511 51	Homogenizers
35511 73	Ice cream freezers
35511 83	Butter and cheese processing plant machinery and equipment
35511 91	Dry milk processing plant machinery and equipment
35511 98	Other dairy and milk products processing plant machinery and equipment, excluding packaging machinery, but including cream separators (capacity over 1,500 pounds per hour)
3552- --	TEXTILE MACHINERY
35521 --	Textile Machinery
	Fiber-to-fabric textile machinery (except parts, attachments, and accessories):
35521 15	Cleaning and opening machinery, including picker, garnetting, and other
35521 25	Carding and combing machines
35521 36	Drawing and roving frames
	Spinning frames:
35521 42	Frames
35521 46	Spindles
	Twisting frames:
35521 47	Frames
35521 48	Spindles
	Yarn preparing machines:
35521 51	Winding machines (skein, bobbin, quill, cone, etc.)
35521 53	Other yarn preparing machines (beaming, warping, warp typing, warp drawing in, slashing, etc.)
35521 55	Other fiber-to-fabric machinery

SIC Code	Industries and Products
	TEXTILE MACHINERY (Continued)
	Fabric machinery (except parts, attachments, and accessories)
35521 65	Power looms (including looms operating without shuttles), all types including cotton and synthetic broadlooms
	Knitting machines
35521 72	Hosiery (circular and full-fashioned)
35521 73	Double knit knitting machinery
35521 77	Warp knitting machines
35521 79	Other knitting machines
35521 84	Other fabric machinery, including lace, embroidery, braiding, and tufting machinery and hand looms
35521 85	Bleaching, dyeing, and finishing machinery
35521 87	Machinery for drying stocks, yarns, cloth, etc.
35521 98	Other textile industry machinery, n.e.c. (except parts, attachments, and accessories)
35522 --	Parts and Attachments for Textile Machinery
35522 11	Textile machinery turnings and shapes (bobbins, shuttles, spools, picker sticks, etc.)
	Parts and attachments
	Fiber-to-fabric machinery
35522 22	Card clothing
35522 31	Other fiber-to-fabric machinery, except card cloth
35522 41	Power looms
35522 45	Knitting machines, excluding needles
35522 53	Fabric machinery, except power looms and knitting machines
35522 71	Bleaching, dyeing, and finishing machinery
35522 98	Other textile industries machinery
35522 00	Parts and attachments for textile machinery, n.s.k.
3553- --	WOODWORKING MACHINERY
35531 --	Woodworking Machinery (Except Home Workshop), Including Parts and Attachments
35531 12	Sawmill equipment
35531 15	Veneer and plywoodmaking, woodbox, and crate-making machinery
35531 62	Sawing machines, except sawmill equipment and chain saws
35531 67	Chain saws

SIC Code	Industries and Products
	WOODWORKING MACHINERY--Continued
35531 71	Jointers, matchers, molders, mortisers, shapers, and tenoners, except power-driven hand-held tools
35531 81	Parts, attachments, and accessories for woodworking machinery (sold separately), excluding sawblades
35531 98	Other woodworking machinery (except power-driven hand-held tools), including lathes, planing machines, and surfacing machines, except hand-held
35531 00	Woodworking machinery (except home workshop) including parts and attachments, n.s.k.
35532 --	Woodworking Machinery for Home Workshop (Except Power-Driven Handtools), Including Parts and Attachments
35532 21	Saws, including circular
35532 81	Parts, attachments, and accessories for machine tools and woodworking machines designed primarily for home workshops, etc. (sold separately), except parts for power-driven handtools (excluding sawblades)
35532 98	Other machine tools and woodworking machines designed primarily for home workshops, etc. (except power-driven handtools), planers, and shapers
3554- --	**PAPER INDUSTRIES MACHINERY**
	Pulp and Paper Industries Machinery (New)
35540 11	Wood preparation equipment, including barkers, chippers, knotters, splitters, chipscreens, etc.
	Pulp mill machinery
35540 21	Grinders (for groundwood)
35540 25	Deckers, thickeners, wet lap machines, bleaching equipment, pulp screens, washers, and save-alls
35540 29	Other pulpmill machinery, including digesters and recovery room equipment
	Papermill machinery
35540 31	Beaters, jordans, and other stock preparation
	Paper machines
35540 45	Calenders, including supercalendars
35540 41	Fourdriniers, including yankee machines
35540 43	Cylinder-type machines
35540 49	Other paper machinery, includimg forming and finishing machinery, but excluding calendars

SIC Code	Industries and Products
	PAPER INDUSTRIES MACHINERY (Continued)
	Paper and paperboard converting equipment
35540 51	Bagmaking machines, including shipping sack machines, and envelope making machines
35540 53	Corrugated boxmaking machines
35540 54	Box, carton, and shipping container making machines, except corrugated box machines
35540 56	Toilet roll and napkin making machines
35540 59	Other paper and paperboard converting equipment, including drum, can and tube making machines
	Rebuilt Pulp and Paper Industries Machinery
35540 71	Rebuilt paper machines, including Fourdriniers, yankees, cylinders, and forming machines
35540 75	Other rebuilt pulp and paper industries machinery
35540 81	Parts and attachments for pulp mill, papermill, and paper converting machinery and equipment, sold separately
3555- --	**PRINTING TRADES MACHINERY**
35551 --	Printing Presses, Offset Lithographic
	Sheet-fed
	Single color
35551 21	From 22 inches up to and including 36 inches maximum sheet size
35551 22	Over 36 inches maximum sheet size
	Multicolor, including perfecting 2- and 3-color:
35551 24	From 22 inches up to and including 36 inches maximum sheet size
35551 25	Over 36 inches maximum sheet size
	Multicolor, including perfecting, 4-color and over:
35551 28	From 22 inches up to and including 36 inches maximum sheet size
35551 29	Over 36 inches maximum sheet size
	Web-fed
35551 32	Newspaper
35551 33	Business form presses
35551 35	Commercial (including heat-set)
35551 36	All other
35552 --	Printing Presses, Other Than Lithographic
	Letterpress (typographical, relief)
35552 16	Sheet-fed, including platen, cylinder, and rotary types

SIC Code	Industries and Products
	PRINTING TRADES MACHINERY (Continued)
	Web-fed
35552 18	Commercial
35552 19	Newspaper
35552 37	Gravure, sheet-fed and web-fed
35552 38	Flexographic, sheet-fed and web-fed 15-100
35552 41	Other printing presses, including metal decorating, proof, and rebuilt
35553 --	**Typesetting Machinery and Equipment**
	Typesetting machinery and equipment (excluding justifying typewriters)
35553 43	Photographic typesetting machine, including integral computer
35553 45	Keyboard input devices
35553 51	Hot metal typesetting machines
35553 53	Matrices for hot metal machines
35553 54	Matrices for phototypesetting machines
35553 56	Other typesetting machines (excluding cameras)
35554 --	**Bindery Equipment**
	Binding machinery and equipment, except papercutting, collating, or gathering machines
35554 63	Saddle binding equipment
35554 64	Perfect and hard case (edition) binding equipment
35554 65	Other binding machinery and equipment, n.e.c., including folding equipment
35555 --	**Other Printing Trades Machinery and Equipment and Parts and Attachments for All Printing Trades Machinery and Equipment**
35555 62	Electrotyping and sterotyping machinery and equipment
35555 61	Other printing industry pre-press preparatory equipment, including photocomposing equipment, etching equipment, etc. (excluding typesetting equipment and cameras)
35555 66	Paper cutting machines
35555 67	Collating and/or gathering machines (sold separately)
35555 69	Engravers' material and equipment, including metalplates, etc.
	Other printing machinery and equipment, including parts, attachments, and accessories for printing trades machinery and equipment (sold separately)

SIC Code	Industries and Products
	PRINTING TRADES MACHINERY (Continued)
	Rollers and blankers and printers' rolls and platens
35555 71	Rubber and plastic
35555 73	Other
35555 74	Platens, excluding typewriter
35555 75	Foundry type, rules, leads, slugs, borders, and ornaments
35555 83	Parts, attachments, and accessories for printing presses (sold separately), including flying pasters, dryers, folders, and reels
35555 85	Parts, attachments, and accessories for typesetting machines (sold separately)
35555 87	Parts, attachments, and accessories for binder equipment (sold separately)
35555 89	Parts, attachments, and accessories for other printing trades machinery and equipment (sold separately)
35555 98	Other printing trades machinery and equipment
3559- --	SPECIAL INDUSTRY MACHINERY, N.E.C.
35591 11	Chemical manufacturing industries machinery and equipment, and parts
35592 --	Foundry Machinery and Equipment
35592 21	Foundry pouring equipment, including ladles, crucibles, and pouring machines
	Molding machines
35592 33	Green sand
35592 35	Other
	Blast cleaning machines
35592 53	Airless, hydraulic, and pneumatic
35592 55	Tumbling and finishing machines
35592 41	Foundry flasks
35592 98	Other foundry machinery, including core-making machines and parts for foundry machinery and equipment
35593 --	Plastics-Working Machinery and Equipment, Excluding Patterns and Molds
35593 11	Compression molding machines
35593 33	Extrusion machines
35593 51	Injection molding machines
35593 61	Blow molding machines
35593 98	Other plastics-working machinery and equipment, including parts for plastics-working machinery

SIC Code	Industries and Products
	SPECIAL INDUSTRY MACHINERY, N.E.C. (Continued)
35593 11	Compression molding machines
35593 33	Extrusion machines
35593 51	Injection molding machines
35593 61	Blow molding machines
35593 98	Other plastics-working machinery and equipment, including parts for plastics-working machinery
35594 --	Rubber-Working Machinery and Equipment, Excluding Tire Molds
35594 11	High-intensity solids mixers
35594 31	Extruding machines
35594 41	Vulcanizing presses
35594 51	Tire-building equipment, except tire molds
35594 71	Tire recapping and repairing machinery and equipment, including recapping vulcanizers
35594 98	Other rubber-working machinery, including caledering machines and parts for rubber-working machinery, but excluding tire molds
35595 --	Other Special Industry Machinery and Equipment
35595 11	Petroleum refinery machinery and equipment, including parts
35595 21	Ammunition and explosives loading machinery and equipment, and parts
	Tobacco manufacturing machinery and equipment
35595 31	Cigarette and cigarmaking machines
35595 33	Cigarette, cigar, and tobacco packaging and wrapping machines
35595 39	Other tobacco manufacturing machinery and equipment, and parts
35595 41	Clayworking machinery and equipment, and parts (brick, tile, and ceramics)
35595 43	Cementmaking machinery and equipment and parts, other than cement kilns
	Concrete products machinery and equipment
35595 45	Concrete block machines
35595 49	Other concrete products machinery and equipment and parts, including concrete pipemaking machines
	Glassmaking machinery and equipment
35595 51	Bottle-forming machines
35595 55	Other glassmaking machinery and equipment and parts, except lehrs

SIC Code	Industries and Products
	SPECIAL INDUSTRY MACHINERY, N.E.C. (Continued)
35595 62	Shoemaking and repairing machinery and equipment and parts, including sole stitching machines
35595 73	Cotton ginning machinery and equipment and parts
35595 81	Metal cleaning, degreasing, finishing, and drying machinery and equipment and parts
35595 85	Electronic tubemaking machinery and equipment and parts
35595 89	Other special industry machinery and equipment and parts, including incandescent lampmaking, paintmaking, stoneworking, hatmaking, leatherworking, jewelers', pharmaceutical, etc.
35595 91	Electric nonmetallic processing industrial furnaces and ovens, including kilns and lehrs
35595 92	Fuel-fired kilns (cement, wood, and chemical processing)
35595 93	Other nonmetallic processing industrial furnaces and ovens and parts, including kilns and lehrs
35595 00	Other special industry machinery and equipment, n.s.k.

Source: 1972 Census of Manufactures.

n.e.c. - not elsewhere classified.
n.s.k. - not specified by kind.

APPENDIX B

SIC 357 - OFFICE, COMPUTING AND ACCOUNTING MACHINES

PRODUCTS PRODUCED

SIC Code	Industries and Products (1)
3772- --	TYPEWRITERS (See SIC 3579)
3573- --	ELECTRONIC COMPUTING EQUIPMENT
35731 00	Electronic Computers
	Digital
35731 11	General purpose
35731 13	Special purpose
35731 22	Analog
35731 25	Hybrid
35732 00	Peripheral Equipment for Electronic Computers
	Auxiliary storage equipment
35732 32	Direct access storage units such as magnetic disk and drum, and magnetic card and bulk core memory
35732 34	Serial access auxiliary storage units such as magnetic tape units
	Input-output equipment
35732 36	Card key entry devices
35732 38	Magnetic media key entry devices
35732 41	Systems oriented punched card equipment
35732 51	Optical scanning devices
35732 53	Magnetic ink recognition devices
35732 55	Graphic displays
35732 61	Printers
35732 63	Industrial control input-output equipment including analog-to-digital converters, digital-to-analog converters, and sensor interfaces
35732 65	All other input-output devices including plotters, paper tape readers, paper tape punches, etc., and off-line punched card equipment, such as tabulators, collators, sorters, and interpreters
	Computer terminals
35732 71	Alphanumeric display terminals based on CRT displays, typically include keyboard and sometimes a serial printer or type cassette (usually designed to operate with voice grade communication facilities)

SIC Code	Industries and Products
	ELECTRONIC COMPUTING EQUIPMENT (Continued)
35732 73	Multifunction terminals
35732 75	Special purpose terminals
	Digital communications interface equipment
35732 81	Line interface equipment, such as modems (adapters, data sets)
35732 83	Multiplexors, including frequency division and time division multiplexors
35732 89	Other types of peripheral equipment
35733 --	Parts and Attachments for Electronic Computing Equipment
3574- --	**CALCULATING AND ACCOUNTING MACHINES**
35741 --	Adding and Calculating Machines, Except Electronic
	Adding machines
35741 21	10 keyboard (hand and electric)
35741 27	Full keyboard, hand and electromechanical
	Calculating machines
35741 31	Printing calculators
35741 35	Rotary and key-driven calculators, hand and electromechanical
35742 --	Electronic Calculating Machines
	General and/or commercial types
35742 36	Display
35742 37	Printing
35742 38	Technical and/or scientific types
35743 --	Accounting Machines and Cash Registers
35743 11	Accounting and bookkeeping machines, including billing machines with accounting registers and electronic accounting machine-type data terminals
35743 51	Cash registers, including adding machines with cash drawers
35743 53	Electronic cash register type point of sale retail devices, including data capturing control registers
35743 61	Coded document sorting machines (excluding punchcard equipment)

SIC Code	Industries and Products
	CALCULATING AND ACCOUNTING MACHINES (Continued)
35743 95	Rebuilt adding, calculating accounting machines, and cash registers
35743 41	Coin and currency handling machines
35743 98	Other calculating and accounting machines except electronic computers and peripheral equipment for electronic computing systems, n.e.c.
35745 --	Parts and Attachments for Adding, Calculating, Accounting Machines and Cash Registers
35745 10	Produced by complete machine manufacturers
35745 31	Produced by other than complete machine manufacturers
3576- --	SCALES AND BALANCES
35760 13	Motor truck scales
35760 15	Railroad truck scales
	Industrial Scales
35760 21	Bench and portable
35760 23	Floor scales, including built-in dormant
35760 25	Predetermined weighing and check weighing scales, all types, except automatic bulk material weighers, fillers, and batching proportioners
35760 27	Automatic bulk material weighers, predetermined weight type, for weighing, filling, batching, and proportioning
35760 29	Miscellaneous industrial scales, including special purpose, crane, suspension, tank, hopper, force measuring devices, and conveyor scales (weigh and feed) for bulk materials
	Retail and Commercial Scales
35760 31	Computing
35760 35	Miscellaneous, including noncomputing counter, cotton beams and steel yards, egg-grading scales, and hanging scales for retail use
	Household and Person Weighing Scales
35760 41	Bathroom
35760 45	Person weighing scales (coin operated and free weighing) and miscellaneous household scales, including kitchen, baby scales, etc.

SIC Code	Industries and Products
	SCALES AND BALANCES (Continued)
35760 51	Mailing and parcel post scales
35760 82	Accessories and attachments (sold separately)
35760 84	Parts for scales and balances sold for assembly elsewhere, repair, service, etc.)
3572- --	TYPEWRITERS
3579- --	OFFICE MACHINES, N.E.C.
35793 00	Duplicating machines
	Spirit
35793 11	Hand
35793 12	Electric
35793 16	Offset
	Stencil
35793 13	Hand
35793 14	Electric
35793 19	Other, including gelatin and ribbon and ink
35794 00	Dictating, Transcribing, and Recording Machines
35794 21	Systems
35794 23	Desk units
35794 25	Portable units
35794 28	Transcribing units, excluding systems tapes
35794 29	Other types
35795 00	Mailing, Letter Handling, and Addressing Machines
35795 41	Mailing machines, including mail sorting machines, mail typing (bundling) machines, mail cancelling (post office) machinery, postage meters, postal permit mailing machines, stamp affixers
35795 43	Letter and envelope handling machines, including envelope stuffing and sealing machines, letter opening machines, letter inserting machines, letter folding, stuffing, and sealing machines
35795 45	Collating machines
35795 47	Addressing machines, including address labeling machines, addressing plates, addressing plate embossers, and addresser-printer machines
35796 00	All Other Office Machines, N.E.C.
35796 31	Check handling machines
35796 32	Electric stapling machines (office type)
35796 33	Time recording and time stamp machines
35796 34	Forms handling equipment, including bursters, decollators, imprinters, autographic registers

SIC Code	Industries and Products
	TYPEWRITERS OFFICE MACHINES, N.E.C. (continued)
35796 98	All other office machines not elsewhere classified, including shorthand writing machines, pencil sharpeners, stapling machines (except electric), papercutters, rebuilt office, computing, and accounting machines not elsewhere classified
35797 --	Typewriters
35797 20	Typewriters, including coded media, except parts and attachments
	Standard (nonportable)
35797 01	Electric
35797 03	Nonelectric
35797 05	Standard portable (including electric)
35797 12	Specialized typewriters and typewriter principal machines
35797 40	Parts and Attachments for Typewriters, Sold Separately
35798 --	Parts and Attachments for Addressing, Dictating, Duplicating and Other Office and Store Machines, N.E.C.
35798 20	Parts and attachments for duplicating machines, sold separately
35798 40	Parts for dictating equipment
35798 50	Parts and attachments for office machines, n.e.c., except duplicating machines and dictating equipment

(1) Reported jointly in 1972 Census data
n.e.c. - not elsewhere classified.
n.s.k. - not specified by kind.

Source: 1972 Census of Manufactures.

Appendix C

General Statistics by Size Distribution of Manufacturing Establishments*

SIC 355 - Special Industry Machinery, Except Metalworking Machinery

Average Number of Employees	Establishments		All Employees		Value Added by Manufacture		Cost of Materials		Value of Shipments		New Capital Expenditures	
	Number	Percent	Number (Thousands)	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent
SIC 3551 Food Products Machinery												
Total	688	100%	31.9	100%	605.2	100%	411.7	100%	1,000.1	100%	21.8	100%
1 - 4	193	28.0	.4	1.2	7.8	1.3	5.5	1.3	13.3	1.3	.3	1.4
5 - 9	86	12.5	.6	1.9	11.0	1.8	6.7	1.6	17.5	1.7	.4	1.8
10 - 19	119	17.3	1.7	5.3	30.5	5.0	20.8	5.0	50.6	5.1	1.2	5.5
20 - 49	133	19.3	4.2	13.1	68.9	11.4	49.8	12.1	118.5	11.8	2.7	12.4
50 - 99	72	10.5	4.8	15.0	85.6	14.1	65.2	15.8	148.4	14.8	3.1	14.2
100 - 249	62	9.0	9.6	30.1	187.4	31.0	132.0	32.1	311.8	31.2	9.4	43.1
250 - 499	15	2.2	4.9	15.3	98.8	16.3	55.8	13.6	152.5	15.3	1.9	8.7
500 - 999	8	1.2	5.8	18.1	115.3	19.1	76.0	18.5	187.6	18.8	2.8	12.9
SIC 3552 Textile Machinery												
Total	578	100%	32.7	100%	487.6	100%	339.6	100%	822.8	100%	27.6	100%
1 - 4	159	27.5	.3	.9	5.1	1.0	3.2	1.0	8.3	1.0	.4	1.4
5 - 9	98	16.9	.7	2.1	10.7	2.2	7.2	2.1	17.8	2.2	.7	2.5
10 - 19	97	16.8	1.4	4.2	18.8	3.8	14.1	4.2	32.8	4.0	1.1	3.9
20 - 49	108	18.7	3.3	10.1	51.6	10.6	38.0	11.2	88.3	10.7	1.9	6.8
50 - 99	54	9.3	3.8	11.6	60.8	12.5	47.0	13.8	106.6	13.0	3.9	14.1
100 - 249	35	6.1	5.5	16.8	79.8	16.4	57.3	16.9	137.1	16.7	3.1	11.1
250 - 499	16	2.8	5.7	17.4	92.5	19.0	69.7	20.5	160.0	19.4	3.9	14.0
500 - 999	7	1.2	5.1	15.5	81.8	16.8	48.6	14.3	132.5	16.1	6.8	24.5
1,000 or More	4	.7	7.0	21.4	86.3	17.7	54.4	16.0	139.5	16.9	6.0	21.7
SIC 3553 Woodworking Machinery												
Total	241	100%	13.5	100%	280.3	100%	217.0	100%	488.0	100%	12.3	100%
1 - 4	60	24.9	.1	.8	2.5	.9	1.7	.7	4.2	.9	.1	.8
5 - 9	39	16.2	.3	2.2	5.0	1.8	3.2	1.5	8.1	1.7	.3	2.5
10 - 19	34	14.1	.5	3.7	9.6	3.4	7.4	3.4	16.6	3.4	.2	1.6
20 - 49	52	21.6	1.6	11.9	29.3	10.5	21.4	9.9	50.0	10.3	1.4	11.4
50 - 99	22	9.1	1.5	11.1	25.8	9.2	17.7	8.1	43.1	8.8	1.1	8.9
100 - 249	23	9.5	3.3	24.4	62.6	22.3	44.7	20.6	107.1	21.9	1.2	9.8
250 - 499	5	2.1	1.8	13.3	34.5	12.3	30.1	13.9	64.1	13.1	2.3	18.7
500 or More	6	2.5	4.4	32.6	111.0	39.6	90.9	41.9	194.7	39.9	5.7	46.3

Average Number of Employees	Establishments		All Employees		Value Added by Manufacture		Cost of Materials		Value of Shipments		New Capital Expenditures	
	Number	Percent	Number (Thousands)	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent
SIC 3554 Paper Industries Machinery												
Total	216	100%	15.3	100%	254.0	100%	193.7	100%	447.8	100%	8.4	100%
1 - 4	44	20.2	.1	.7	1.8	.7	1.6	.8	3.3	.8	.4	4.8
5 - 9	32	14.7	.2	1.3	5.2	2.0	4.1	2.1	9.3	2.1	.2	2.4
10 - 19	33	15.1	.5	3.3	8.7	3.4	6.1	3.1	14.5	3.2	.3	3.6
20 - 49	47	21.6	1.6	10.4	23.0	9.1	13.8	7.1	39.5	8.8	.7	8.3
50 - 99	27	12.4	1.9	12.4	34.8	13.7	23.6	12.2	57.9	12.9	1.7	20.2
100 - 249	20	9.2	3.2	20.9	56.3	22.2	44.7	23.1	102.4	22.9	1.3	15.5
250 - 499	11	5.0	3.7	24.2	57.4	22.6	46.1	23.8	102.1	22.8	1.5	17.8
500 or More	4	1.8	4.1	26.8	66.8	26.3	53.8	27.8	118.8	26.5	2.3	27.4
SIC 3555 Printing Trades Machinery												
Total	574	100%	23.9	100%	503.6	100%	317.2	100%	823.5	100%	20.1	100%
1 - 4	204	35.5	.3	1.2	7.0	1.4	4.7	1.5	12.2	1.5	.2	1.0
5 - 9	101	17.6	.7	2.9	12.7	2.5	7.6	2.4	20.3	2.5	.3	1.5
10 - 19	96	16.7	1.4	5.8	26.1	5.2	16.1	5.1	41.8	5.1	.8	4.0
20 - 49	84	14.6	2.6	10.8	46.3	9.2	27.0	8.5	72.4	8.8	1.5	7.5
50 - 99	40	7.0	2.7	11.2	53.5	10.6	31.6	10.0	89.0	10.8	6.6	32.8
100 - 249	27	4.7	4.2	17.5	94.9	18.9	53.1	16.7	151.8	18.4	1.8	8.9
250 - 499	13	2.3	4.5	18.8	98.8	19.6	67.3	21.2	173.5	21.0	3.0	14.9
500 or More	9	1.6	7.6	31.8	164.2	32.6	109.6	34.6	262.6	31.9	5.9	29.4
SIC 3559 Special Industry Machinery, N.E.C.												
Total	1,382	100%	72.2	100%	1,587.1	100%	1,090.1	100%	2,603.9	100%	78.8	100%
1 - 4	423	30.6	.8	1.1	16.4	1.0	13.0	1.2	29.4	1.1	1.3	1.8
5 - 9	198	14.3	1.3	1.8	25.2	1.6	20.5	1.9	45.5	1.7	1.1	1.5
10 - 19	238	17.2	3.3	4.6	58.3	3.7	44.2	4.0	101.8	3.9	2.7	3.6
20 - 49	248	18.0	7.9	10.9	149.4	9.4	114.2	10.5	261.6	10.1	8.1	11.0
50 - 99	129	9.3	9.0	12.5	147.8	9.3	126.0	11.5	278.2	10.7	8.4	11.4
100 - 249	80	5.8	11.9	16.5	220.7	13.9	165.5	15.2	380.1	14.6	10.0	13.5
250 - 499	38	2.8	13.4	18.6	298.8	18.8	203.4	18.7	486.5	18.7	18.9	25.6
500 - 999	21	1.5	15.2	21.1	277.5	17.5	252.3	23.1	521.9	20.0	9.6	13.0
1,000 - 2,499	7	.5	9.3	12.9	393.0	24.8	151.1	13.9	498.8	19.2	13.7	18.6

*Source: 1972 Census of Manufactures, U.S. Department of Commerce.

Appendix D

General Statistics by Size Distribution of Manufacturing Establishments[a]

SIC 357 - Office, Computing and Accounting Machines

Average Number of Employees	Establishments		All Employees		Value Added by Manufacture		Cost of Materials		Value of Shipments		New Capital Expenditures	
	Number	Percent	Number (Thousands)	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent
SIC 3572 - Typewriters **SIC 3579 - Office Machines**												
Total	217	100%	34.6	100%	887.0	100%	416.4	100%	1,296.1	100%	49.4	100%
1 - 4	78	35.9	.1	.3	2.7	.3	1.4	.3	4.0	.3	.1	.2
5 - 9	29	13.4	.2	.6	4.2	.5	2.2	.5	6.6	.5	.1	.2
10 - 19	13	6.0	.2	.6	4.2	.5	1.7	.4	5.7	.4	.2	.5
20 - 49	26	12.0	.8	2.3	16.5	1.9	8.8	2.1	25.6	2.0	.3	.7
50 - 99	20	9.2	1.4	4.0	15.8	1.8	17.3	4.2	35.7	2.8	.5	1.0
100 - 249	24	11.0	3.7	10.7	73.2	8.2	36.8	8.8	110.0	8.5	4.6	9.3
250 - 499	13	6.0	4.7	13.6	94.1	10.6	36.0	8.7	133.9	10.3	3.0	6.1
500 - 999	6	2.8	4.0	11.6	118.1	13.3	44.4	10.7	164.2	12.7	.9	1.8
1,000 or More	8	3.7	19.4	56.3	588.3	62.9	267.7	64.3	810.7	62.5	39.6	80.2
SIC 3573 - Electronic Computing Equipment												
Total	601	100%	146.6	100%	3,410.7	100%	2,978.9	100%	6,387.0	100%	212.7	100%
1 - 9	119	19.8	.2	.1	3.8	.1	3.7	.1	8.1	.1	1.5	.7
5 - 9	61	10.1	.4	.3	6.6	.2	5.1	.2	11.7	.2	1.2	.5
10 - 19	67	11.1	.9	.6	17.5	.5	11.0	.3	27.6	.4	1.4	.6
20 - 49	95	15.8	3.0	2.1	53.5	1.6	40.0	1.3	89.4	1.4	4.3	2.0
50 - 99	89	14.8	6.2	4.3	100.4	3.2	67.7	2.3	166.4	2.6	11.9	5.6
100 - 249	69	11.5	11.1	7.7	238.1	7.0	136.3	4.6	362.0	5.7	14.2	6.7
250 - 499	37	6.2	13.2	9.1	237.6	6.9	137.5	6.6	391.8	6.2	13.7	6.4
500 - 999	29	4.8	21.1	14.6	526.0	15.4	356.4	12.0	869.5	13.6	22.4	10.5
1,000 - 2,499	22	3.7	31.2	21.6	859.3	25.2	675.8	22.7	1,552.5	24.3	46.7	22.0
2,500 or More	13.	2.2	57.3	39.6	1,359.9	39.9	1,485.4	49.9	2,908.0	45.5	93.5	45.0

Average Number of Employees	Establishments		All Employees		Value Added by Manufacture		Cost of Materials		Value of Shipments		New Capital Expenditures	
	Number	Percent	Number (Thousands)	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent	Million Dollars	Percent
SIC 3574 - Calculating, Accounting Machines												
Total	79	100%	22.2	100%	399.1	100%	253.9	100%	626.6*>	100%	19.0	100%
1 - 9	28	35.4	.1	.4	1.1	.3	.5	.2	1.6	.2	.1	.5
5 - 9	10	12.7	.1	.4	2.2	.6	.7	.3	2.9	.5	.1	.5
10 - 19	11	13.9	.2	.9	4.2	1.0	2.2	.9	6.4	1.0	.2	1.0
20 - 49	6	7.6	.2	.9	3.0	.8	.7	.3	3.7	.6	.1	.5
50 - 99	7	8.9	.6	2.7	9.7	2.4	6.5	2.6	16.0	2.6	.4	2.1
100 - 249	0	-	0	-	0	-	0	-	0	-	0	-
250 - 499	7	8.8	2.1	9.5	48.3	12.1	33.7	13.2	79.4	12.7	2.5	13.2
500 or More	10	12.7	18.9	85.2	330.6	82.8	209.6	82.5	516.6	82.4	15.6	82.2
SIC 3576 - Scales, Balances, Except Laboratory												
Total	96	100%	6.4	100%	129.0	100%	73.7	100%	198.5	100%	5.5	100%
1 - 4	27	28.1	N/A		.7	.5	.4	.5	1.1	.6	N/A	
5 - 9	8	8.3	N/A		1.0	.8	.4	.5	1.4	.7	N/A	
10 - 19	18	18.7	.2	3.1	4.2	3.3	2.2	3.0	6.1	3.1	.1	1.8
20 - 49	21	21.9	.7	10.9	12.0	9.3	9.3	12.6	21.1	10.6	.1	1.8
50 - 99	5	5.2	.4	6.3	6.6	5.1	4.1	5.6	10.3	5.2	.1	1.8
100 - 249	11	11.5	2.0	31.3	34.0	26.4	17.5	23.7	51.0	25.7	3.2	58.2
250 or More	6	6.3	3.1	48.4	70.5	54.6	39.9	54.1	107.5	54.1	2.0	36.4

*Source: 1972 Census of Manufactures, U.S. Department of Commerce.

Appendix E

Age Distribution of Manufacturing Establishments*

States	EPA Region	SIC 3551 Food Products Machinery: Age Range (Years) 1-10	11-20	21-50	51 and Up	Non-available	SIC 3551 Total	SIC 3552 Textile Machinery: Age Range (Years) 1-10	11-20	21-50	51 and Up	Non-available	SIC 3552 Total
Alabama	IV	2	0	0	0	0	2	2	1	1	0	5	9
Alaska	X	0	0	0	0	0	0	0	0	0	0	0	0
Arizona	IX	0	0	0	0	0	0	0	1	0	0	1	2
Arkansas	VI	3	1	0	0	1	5	1	0	0	0	0	1
California	IX	66	48	47	4	27	190	11	2	3	0	3	19
Colorado	VIII	4	0	2	0	1	7	3	0	0	0	0	3
Connecticut	I	6	4	3	2	4	19	4	4	2	1	0	11
Delaware	III	0	2	0	0	0	2	0	0	0	0	0	0
Florida	IV	17	6	2	0	6	31	5	1	1	0	3	10
Georgia	IV	7	2	7	0	3	19	26	13	12	2	10	63
Hawaii	IX	2	0	0	0	1	3	1	0	0	0	0	1
Idaho	X	1	3	1	0	0	5	0	0	0	0	0	0
Illinois	V	44	23	29	8	26	130	9	1	6	1	5	22
Indiana	V	11	6	8	2	4	31	1	0	2	0	0	3
Iowa	VII	9	8	6	1	4	28	0	0	0	1	0	1
Kansas	VII	10	3	4	0	6	23	0	0	0	2	0	2
Kentucky	IV	2	1	2	0	2	7	2	1	1	0	2	6
Louisiana	VI	3	3	4	0	0	10	0	0	1	0	0	1
Maine	I	0	0	1	0	0	1	1	2	0	0	0	3
Maryland	III	4	7	3	1	8	23	1	0	1	0	0	2
Massachusetts	I	12	7	7	1	4	31	26	15	32	10	12	95
Michigan	V	5	4	14	4	4	31	3	1	1	0	1	6
Minnesota	V	11	13	7	1	5	37	2	0	0	0	0	2
Mississippi	IV	0	0	0	0	0	0	0	0	0	0	0	0
Missouri	VII	8	4	5	0	7	24	0	0	1	0	2	3
Montana	VIII	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska	VII	5	2	1	0	1	9	1	0	0	0	0	1
Nevada	IX	0	0	0	0	0	0	1	0	0	0	0	1
New Hampshire	I	0	0	1	0	0	1	4	0	3	0	0	7
New Jersey	II	17	12	11	1	3	44	18	13	26	3	4	64
New Mexico	VI	0	0	0	0	0	0	0	0	0	0	0	0
New York	II	32	13	48	4	14	113	20	14	22	4	0	60
North Carolina	IV	4	0	5	0	3	12	52	37	40	3	20	152
North Dakota	VIII	1	1	0	0	0	2	0	0	0	0	0	0
Ohio	V	14	11	25	4	16	70	1	0	5	1	0	7
Oklahoma	VI	1	0	4	0	0	5	1	0	0	0	0	1
Oregon	X	7	3	6	0	2	18	1	0	0	0	0	1
Pennsylvania	III	9	11	14	4	6	44	16	8	13	3	9	49
Rhode Island	I	2	0	0	0	0	2	6	9	8	3	8	35
South Carolina	IV	1	1	0	0	3	5	26	12	12	1	27	78
South Dakota	VIII	0	0	0	0	0	0	0	0	0	0	0	0
Tennessee	IV	3	2	1	0	3	9	6	2	1	0	2	11
Texas	VI	7	3	8	0	6	24	1	0	0	0	1	2
Utah	VIII	6	1	2	0	1	10	1	0	0	0	0	1
Vermont	I	1	1	1	1	0	4	0	0	1	0	1	2
Virginia	III	6	0	0	0	6	12	3	1	0	0	1	5
Washington	X	9	2	6	0	3	20	4	0	1	0	0	5
West Virginia	III	0	0	1	0	0	1	0	0	0	0	1	1
Wisconsin	V	18	11	20	3	17	69	1	1	4	0	0	6
Wyoming	VIII	0	0	0	0	0	0	0	0	0	0	0	0
National		370	225	306	41	193	1,135	263	141	198	33	126	763
EPA Region													
I		21	12	13	4	8	58	41	30	46	14	21	152
II		49	27	59	5	17	157	38	29	46	7	12	132
III		19	20	18	5	20	82	20	9	14	3	11	57
IV		36	12	17	0	20	85	119	67	68	6	68	329
V		103	68	108	22	72	368	17	3	18	2	6	46
VI		14	9	16	0	5	44	3	0	1	0	1	5
VII		32	19	11	1	18	86	1	0	1	3	2	7
VIII		11	2	4	0	2	19	0	0	0	0	0	6
IX		68	48	47	4	28	193	12	3	3	0	4	23
X		17	8	13	0	5	43	5	0	1	0	0	6

		SIC 3553 Woodworking Machinery						SIC 3554 Paper Industries Machinery					
		Age Range (Years)				Non-	SIC 3553	Age Range (Years)				Non-	SIC 3554
States	EPA Region	1-10	11-20	21-30	31 and Up	available	Total	1-10	11-20	21-30	31 and Up	available	Total
Alabama	IV	2	4	0	0	0	6	1	4	0	0	0	5
Alaska	X	0	0	0	0	0	0	0	0	0	0	0	0
Arizona	IX	2	0	0	0	0	2	1	0	0	0	0	1
Arkansas	VI	4	1	0	0	0	5	0	1	0	0	0	1
California	IX	10	8	10	0	4	32	6	1	3	0	1	11
Colorado	VIII	1	0	1	0	0	2	0	0	0	0	0	0
Connecticut	I	2	0	1	0	0	3	1	1	0	0	1	3
Delaware	III	0	0	0	0	0	0	0	0	0	0	0	0
Florida	IV	3	0	1	0	0	4	1	0	0	0	1	2
Georgia	IV	4	1	0	0	1	6	1	3	2	0	1	7
Hawaii	IX	0	0	0	0	0	0	0	0	0	0	0	0
Idaho	X	1	0	0	0	0	1	0	0	0	0	0	0
Illinois	V	9	4	8	4	1	26	7	4	3	0	3	17
Indiana	V	3	2	2	1	3	11	2	0	2	1	1	6
Iowa	VII	1	0	0	0	0	1	0	0	0	0	0	0
Kansas	VII	1	0	0	0	1	2	0	1	0	0	0	1
Kentucky	IV	2	3	0	0	0	5	0	0	0	0	0	0
Louisiana	VI	2	0	0	0	1	3	0	1	0	0	1	2
Maine	I	0	2	2	0	0	4	4	1	1	0	1	7
Maryland	III	0	0	2	0	0	2	2	1	0	0	2	5
Massachusetts	I	4	2	7	1	1	15	17	10	9	9	11	56
Michigan	V	11	2	5	1	3	22	2	1	1	0	1	5
Minnesota	V	2	1	0	2	0	5	3	0	0	0	0	3
Mississippi	IV	3	3	0	0	1	7	1	0	0	0	0	1
Missouri	VII	2	2	3	0	0	7	4	1	1	0	0	6
Montana	VIII	1	0	1	0	0	2	0	0	0	0	0	0
Nebraska	VII	0	1	0	0	0	1	0	0	0	0	0	0
Nevada	IX	0	0	0	0	0	0	0	0	0	0	0	0
New Hampshire	I	1	2	0	0	0	3	3	1	2	0	1	7
New Jersey	II	1	3	3	1	1	9	5	6	8	0	3	22
New Mexico	VI	0	0	0	0	0	0	0	0	0	0	0	0
New York	II	5	2	5	1	0	13	17	15	16	1	7	56
North Carolina	IV	8	7	5	0	1	21	1	0	0	0	1	2
North Dakota	VIII	0	0	0	0	0	0	0	0	0	0	0	0
Ohio	V	2	1	0	2	4	9	6	10	3	2	4	25
Oklahoma	VI	1	0	0	0	1	2	0	0	1	0	0	1
Oregon	X	18	22	16	0	3	59	3	5	2	0	0	10
Pennsylvania	III	1	5	7	2	1	16	4	6	6	0	1	17
Rhode Island	I	0	0	0	1	0	1	1	2	0	0	0	3
South Carolina	IV	0	0	0	0	0	0	0	0	0	0	0	0
South Dakota	VIII	0	0	0	0	0	0	0	0	0	0	0	0
Tennessee	IV	3	3	4	0	0	10	2	0	0	0	0	2
Texas	VI	9	1	1	0	2	13	2	0	0	0	0	2
Utah	VIII	1	0	0	0	0	1	0	0	0	0	0	0
Vermont	I	1	4	0	1	0	6	0	0	1	0	0	1
Virginia	III	3	2	1	0	0	6	1	1	0	0	0	2
Washington	X	7	11	8	0	3	29	1	0	1	1	1	4
West Virginia	III	0	0	0	0	0	0	0	0	1	0	0	1
Wisconsin	V	11	5	1	2	1	20	7	8	13	5	2	35
Wyoming	VIII	0	0	0	0	0	0	0	0	0	0	0	0
National		142	104	94	19	33	392	106	84	74	19	46	329
EPA Region													
I		8	10	10	3	1	32	26	15	13	9	14	77
II		6	5	8	2	1	22	22	21	22	1	12	78
III		4	7	10	2	1	24	7	8	7	0	3	25
IV		25	21	10	0	3	52	7	7	2	0	3	19
V		38	15	16	12	12	93	27	23	22	8	11	91
VI		16	2	1	0	4	30	2	2	1	0	1	6
VII		4	3	3	0	1	11	4	2	1	0	0	7
VIII		3	0	2	0	0	3	0	0	0	0	0	0
IX		30	8	10	0	4	34	7	1	3	0	1	12
X		8	33	24	0	6	89	4	5	3	1	1	14

States	EPA Region	SIC 3555 Printing Trades Machinery						SIC 3559 Special Industry Machinery, N.E.C.					
		Age Range (Years)						Age Range (Years)					
		1-10	11-20	21-30	31 and Up	Non-Available	SIC 3555 Total	1-10	11-20	21-30	31 and Up	Non-Available	SIC 3559 Total
Alabama	IV	1	3	1	0	0	5	9	3	2	1	1	16
Alaska	X	0	0	0	0	0	0	0	0	0	0	0	0
Arizona	IX	1	0	1	0	0	2	6	4	1	0	2	13
Arkansas	VI	0	1	0	0	0	1	2	1	2	0	0	5
California	IX	23	16	18	1	15	73	80	40	41	1	27	189
Colorado	VIII	1	1	3	0	0	5	4	3	1	1	2	11
Connecticut	I	9	0	4	1	1	15	18	12	17	3	9	59
Delaware	III	0	0	0	0	0	0	0	0	2	0	0	2
Florida	IV	5	6	0	0	3	14	20	4	5	1	2	32
Georgia	IV	7	1	1	0	3	12	6	4	1	2	1	14
Hawaii	IX	0	0	0	0	0	0	0	1	0	0	0	1
Idaho	X	0	0	0	0	0	0	1	0	0	0	0	1
Illinois	V	39	35	30	6	15	125	56	38	44	7	13	158
Indiana	V	5	2	1	0	0	8	20	5	12	3	3	43
Iowa	VII	1	1	0	0	4	6	6	8	2	0	1	17
Kansas	VII	0	1	2	0	0	3	6	0	1	0	3	10
Kentucky	IV	3	1	3	2	0	9	8	2	3	1	3	17
Louisiana	VI	5	0	1	0	1	7	4	1	0	1	1	7
Maine	I	0	0	0	0	0	0	0	2	1	0	3	6
Maryland	III	7	2	4	1	3	17	9	3	3	0	2	19
Massachusetts	I	25	12	11	3	8	59	47	29	32	6	25	139
Michigan	V	8	6	10	3	6	33	53	31	45	2	24	155
Minnesota	V	3	3	3	1	1	11	19	8	9	0	1	37
Mississippi	IV	0	1	0	0	0	1	0	1	0	0	1	2
Missouri	VII	7	13	7	0	2	29	7	8	4	0	1	20
Montana	VIII	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska	VII	1	1	0	0	0	2	0	1	1	0	0	2
Nevada	IX	0	0	0	0	0	0	0	1	0	0	0	1
New Hampshire	I	1	0	0	0	5	6	4	4	2	1	0	11
New Jersey	II	23	20	16	4	25	88	45	47	47	2	18	159
New Mexico	VI	1	0	0	0	0	1	0	0	0	0	0	0
New York	II	55	41	44	2	13	155	42	41	55	7	12	157
North Carolina	IV	3	2	1	0	2	8	8	3	5	0	1	19
North Dakota	VIII	0	0	0	0	0	0	3	0	2	0	0	5
Ohio	V	16	14	18	0	14	62	94	68	65	7	30	264
Oklahoma	VI	1	0	0	0	1	2	4	5	2	0	2	13
Oregon	X	4	2	1	0	1	8	14	3	1	0	1	19
Pennsylvania	III	17	15	13	3	9	57	35	27	35	2	20	119
Rhode Island	I	2	1	1	0	1	5	10	5	5	0	2	22
South Carolina	IV	0	2	0	0	0	2	6	1	1	0	0	8
South Dakota	VII	0	0	0	0	1	1	1	0	1	0	0	2
Tennessee	IV	1	1	0	0	3	5	10	0	5	1	0	16
Texas	VI	7	3	1	0	2	13	23	12	7	0	9	51
Utah	VIII	0	1	0	0	0	1	2	1	1	0	0	4
Vermont	I	0	0	0	0	0	0	1	1	0	3	0	5
Virginia	III	6	2	1	0	1	10	6	1	6	0	2	15
Washington	X	4	6	1	0	0	11	8	6	1	0	1	16
West Virginia	III	0	0	0	0	0	0	4	3	1	0	2	10
Wisconsin	V	7	3	9	0	1	20	17	6	14	4	10	51
Wyoming	VIII	0	0	0	0	0	0	0	0	0	0	0	0
National		299	319	206	27	141	892	714	426	489	56	257	1,942
EPA Region													
I		37	13	16	4	15	85	80	53	57	13	39	242
II		78	61	60	6	38	243	87	88	102	9	30	316
III		30	19	18	4	13	86	54	34	69	2	26	163
IV		20	17	6	2	11	36	65	20	24	6	9	124
V		78	63	71	10	37	259	257	136	189	23	103	708
VI		14	4	2	0	4	24	33	19	11	1	12	76
VII		9	16	9	0	7	41	20	17	9	0	3	51
VIII		1	2	3	0	0	6	9	4	4	1	2	20
IX		24	16	19	1	13	73	86	46	42	1	29	206
X		8	8	2	0	1	19	23	9	2	0	2	38

Note: Totals shown are different than those in Table , page 36, because of the different data source. Totals are also different than shown in Table , page 42, because Appendix E totals include non-reporting companies and Table totals do not.

*Source: Dun & Bradstreet Listing of 6,900 Manufacturing Establishments, April 1975.

Appendix F

Age Distribution of Manufacturing Establishments*

States	EPA Region	SIC 3572 Typewriters: Age Range (Years) 1-10	11-20	21-30	31 and Up	Non-Available	SIC 3572 Total	SIC 3573 Electronic Computing Equipment: Age Range (Years) 1-10	11-20	21-30	31 and Up	Non-Available	SIC 3573 Total
Alabama	IV	0	0	0	0	0	0	1	0	0	0	1	2
Alaska	X	0	0	0	0	0	0	0	0	0	0	0	0
Arizona	IX	0	0	0	0	0	0	14	2	0	0	4	20
Arkansas	VI	0	0	0	0	0	0	1	0	0	0	0	1
California	IX	1	3	0	0	0	4	131	21	10	0	64	226
Colorado	VIII	0	0	0	0	0	0	16	0	0	0	3	19
Connecticut	I	0	0	0	0	1	1	13	1	2	0	3	19
Delaware	III	0	0	0	0	0	0	0	0	0	0	0	0
Florida	IV	0	0	0	0	1	1	12	4	0	0	7	23
Georgia	IV	0	0	0	0	0	0	8	0	0	0	11	19
Hawaii	IX	0	0	0	0	0	0	0	0	0	0	0	0
Idaho	X	0	0	0	0	0	0	0	1	0	0	0	1
Illinois	V	0	0	0	0	4	4	18	1	2	2	10	31
Indiana	V	0	1	0	0	0	1	1	1	2	0	0	4
Iowa	VII	0	0	0	0	0	0	1	0	0	0	0	1
Kansas	VII	0	0	0	0	0	0	3	1	0	0	2	6
Kentucky	IV	0	0	0	0	2	2	0	0	0	0	1	1
Louisiana	VI	1	0	0	0	0	1	1	0	0	0	0	1
Maine	I	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	III	0	0	0	0	0	0	8	1	0	0	5	14
Massachusetts	I	0	0	0	0	0	0	61	13	4	0	22	101
Michigan	V	0	0	0	0	0	0	12	0	2	2	12	28
Minnesota	V	0	0	0	0	0	0	13	3	0	1	27	44
Mississippi	IV	0	0	0	0	0	0	0	0	0	0	0	0
Missouri	VII	1	0	0	0	1	2	2	2	0	0	0	4
Montana	VIII	0	0	0	0	0	0	1	0	0	0	0	1
Nebraska	VII	0	0	0	0	0	0	1	0	0	0	1	2
Nevada	IX	0	0	0	0	0	0	0	0	0	0	0	0
New Hampshire	I	0	0	0	0	0	0	4	0	0	0	0	4
New Jersey	II	1	0	1	0	2	4	35	3	1	1	12	52
New Mexico	VI	0	0	0	0	0	0	2	0	0	0	0	2
New York	II	1	2	3	0	7	13	40	11	7	3	16	77
North Carolina	IV	0	0	0	0	0	0	4	0	0	0	5	9
North Dakota	VIII	0	0	0	0	0	0	0	0	0	0	1	1
Ohio	V	0	0	0	0	1	1	12	3	0	0	9	24
Oklahoma	VI	1	0	0	0	0	1	3	2	0	0	1	6
Oregon	X	0	0	0	0	0	0	2	0	0	0	2	4
Pennsylvania	III	0	0	0	0	1	1	21	2	1	0	18	42
Rhode Island	I	0	0	0	0	0	0	2	1	0	0	1	4
South Carolina	IV	0	0	0	0	0	0	0	0	0	0	1	1
South Dakota	VII	0	0	0	0	0	0	0	0	0	0	2	2
Tennessee	IV	0	0	0	0	0	0	2	0	0	0	1	3
Texas	VI	0	0	0	0	0	0	20	4	1	0	10	35
Utah	VIII	0	0	0	0	0	0	7	0	0	0	1	8
Vermont	I	0	0	0	0	0	0	0	0	0	0	2	2
Virginia	III	0	1	1	0	3	5	4	0	1	0	4	9
Washington	X	0	0	0	0	0	0	14	0	1	0	1	16
West Virginia	III	0	0	0	0	0	0	0	0	0	0	0	0
Wisconsin	V	0	0	0	0	0	0	3	0	0	0	0	3
Wyoming	VIII	0	0	0	0	0	0	0	0	0	0	1	1
National		6	9	5	0	25	45	494	77	34	9	263	877
EPA Region													
	I	0	0	0	0	1	1	81	15	6	0	28	130
	II	2	4	4	0	11	19	75	14	8	4	28	129
	III	0	1	1	0	4	6	33	3	2	0	27	65
	IV	0	0	0	0	3	3	27	4	0	0	27	58
	V	0	1	0	0	5	6	61	8	6	5	59	138
	VI	2	0	0	0	0	2	27	6	1	0	13	45
	VII	1	0	0	0	1	2	7	3	0	0	3	15
	VIII	0	0	0	0	0	0	22	0	0	0	7	30
	IX	1	3	0	0	0	4	143	23	10	0	68	244
	X	0	0	0	0	0	0	16	1	1	0	3	21

States	EPA Region	SIC 3574 Calculating and Accounting Machines: Age Ranges (Years) 1-10	11-20	21-30	31 and Up	Non-Available	SIC 3574 Total
Alabama	IV	2	0	0	0	0	2
Alaska	X	0	0	0	0	0	0
Arizona	IX	0	0	0	0	0	0
Arkansas	VI	0	0	0	0	1	1
California	IX	4	4	1	0	3	12
Colorado	VIII	0	0	0	0	1	1
Connecticut	I	0	1	1	0	1	3
Delaware	III	0	0	0	0	1	1
Florida	IV	0	0	0	0	1	1
Georgia	IV	0	0	0	0	0	0
Hawaii	IX	0	0	0	0	0	0
Idaho	X	0	0	0	0	0	0
Illinois	V	6	2	4	0	4	16
Indiana	V	0	1	0	0	0	1
Iowa	VII	0	0	0	0	0	0
Kansas	VII	0	0	0	0	0	0
Kentucky	IV	0	0	0	0	1	1
Louisiana	VI	0	0	0	0	1	1
Maine	I	0	0	0	0	0	0
Maryland	III	0	0	0	0	3	3
Massachusetts	I	3	0	0	2	0	5
Michigan	V	1	0	2	3	2	8
Minnesota	V	0	0	0	0	1	1
Mississippi	IV	0	0	0	0	0	0
Missouri	VII	1	0	1	0	0	2
Montana	VIII	1	0	0	0	0	1
Nebraska	VII	1	0	0	0	0	1
Nevada	IX	0	0	0	0	0	0
New Hampshire	I	0	0	0	0	0	0
New Jersey	II	1	1	0	0	1	3
New Mexico	VI	0	0	0	0	1	1
New York	II	3	3	1	0	0	7
North Carolina	IV	0	0	0	0	0	0
North Dakota	VIII	0	0	0	0	0	0
Ohio	V	0	1	0	2	1	4
Oklahoma	VI	0	0	0	0	0	0
Oregon	X	0	0	0	0	0	0
Pennsylvania	III	0	0	0	0	0	0
Rhode Island	I	0	1	0	0	0	1
South Carolina	IV	0	0	0	0	1	1
South Dakota	VII	0	0	0	0	0	0
Tennessee	IV	1	0	0	0	1	2
Texas	VI	1	0	0	0	0	1
Utah	VIII	1	0	0	0	0	1
Vermont	I	0	0	0	0	0	0
Virginia	III	0	0	0	0	0	0
Washington	X	0	0	0	0	0	0
West Virginia	III	0	0	0	0	0	0
Wisconsin	V	0	0	0	2	0	2
Wyoming	VIII	0	0	0	0	0	0
National		26	14	10	9	25	84
EPA Region							
I		3	2	1	2	1	9
II		4	4	1	0	1	10
III		0	0	0	0	4	4
IV		3	0	0	0	4	7
V		7	4	6	7	8	32
VI		1	0	0	0	3	4
VII		2	0	1	0	0	3
VIII		2	0	0	0	1	3
IX		4	4	1	0	3	12
X		0	0	0	0	0	0

States	EPA Region	SIC 3576 Scales and Balances Except Laboratory: Age Ranges (Years) 1-10	11-20	21-30	31 and Up	Non-Available	SIC 3576 Total
Alabama	IV	1	1	0	0	0	2
Alaska	X	0	0	0	0	0	0
Arizona	IX	0	0	0	0	0	0
Arkansas	VI	0	1	0	0	0	1
California	IX	4	8	2	0	5	19
Colorado	VIII	0	0	1	1	0	2
Connecticut	I	2	1	1	0	0	4
Delaware	III	0	0	0	0	0	0
Florida	IV	1	1	0	0	0	2
Georgia	IV	0	0	1	0	1	2
Hawaii	IX	0	0	0	0	0	0
Idaho	X	0	0	0	0	0	0
Illinois	V	6	4	5	2	4	21
Indiana	V	1	0	0	0	0	1
Iowa	VII	2	1	0	0	1	4
Kansas	VII	0	0	0	1	0	1
Kentucky	IV	0	1	0	0	2	3
Louisiana	VI	0	0	0	0	0	0
Maine	I	0	0	0	0	0	0
Maryland	III	0	0	2	0	0	2
Massachusetts	I	1	1	0	0	0	2
Michigan	V	3	0	0	0	1	4
Minnesota	V	0	0	0	0	1	1
Mississippi	IV	0	0	0	0	1	1
Missouri	VII	0	0	2	0	0	2
Montana	VIII	0	0	0	0	0	0
Nebraska	VII	0	0	0	0	0	0
Nevada	IX	1	0	0	0	1	2
New Hampshire	I	0	1	0	0	0	1
New Jersey	II	1	5	4	0	0	10
New Mexico	VI	0	0	0	0	0	0
New York	II	5	3	1	0	1	10
North Carolina	IV	1	0	0	0	0	1
North Dakota	VIII	0	0	0	0	0	0
Ohio	V	0	2	2	0	6	10
Oklahoma	VI	1	3	0	0	0	4
Oregon	X	0	2	0	0	0	2
Pennsylvania	III	1	1	2	1	1	6
Rhode Island	I	0	0	0	0	0	0
South Carolina	IV	0	0	0	0	1	1
South Dakota	VII	0	0	0	0	0	0
Tennessee	IV	1	0	0	0	0	1
Texas	VI	2	2	0	0	0	4
Utah	VIII	0	0	0	0	2	2
Vermont	I	0	1	0	0	2	3
Virginia	III	0	0	0	0	0	0
Washington	X	3	0	0	0	0	3
West Virginia	III	0	0	0	0	0	0
Wisconsin	V	1	0	0	0	1	2
Wyoming	VIII	0	0	0	0	0	0
National		38	39	23	5	31	136
EPA Region							
I		3	4	1	0	2	10
II		6	8	5	0	1	20
III		1	3	4	1	1	8
IV		4	3	1	0	5	13
V		11	6	7	2	13	39
VI		3	6	0	0	0	9
VII		2	1	2	1	1	7
VIII		0	0	1	1	2	4
IX		5	8	2	0	6	21
X		3	2	0	0	0	5

		SIC 3579 Office Machines, N.E.C.					
		Age Range (Years)					
States	EPA Region	1-10	11-20	21-30	31 and Up	Non-Available	SIC 3579 Total
Alabama	IV	1	0	0	0	1	2
Alaska	X	0	0	0	0	0	0
Arizona	IX	1	2	0	0	0	3
Arkansas	VI	1	1	0	0	0	2
California	IX	19	4	8	0	9	40
Colorado	VIII	0	1	0	0	2	3
Connecticut	I	2	0	1	1	1	5
Delaware	III	0	1	0	0	0	1
Florida	IV	5	3	1	0	0	9
Georgia	IV	3	0	0	1	3	7
Hawaii	IX	0	0	0	0	0	0
Idaho	X	0	0	0	0	0	0
Illinois	V	10	7	12	5	9	43
Indiana	V	1	1	0	0	0	2
Iowa	VII	0	0	1	0	0	1
Kansas	VII	0	0	0	0	0	0
Kentucky	IV	1	0	1	0	1	3
Louisiana	VI	1	0	0	0	1	2
Maine	I	0	0	0	0	1	1
Maryland	III	1	0	1	0	0	2
Massachusetts	I	5	7	8	2	4	26
Michigan	V	2	1	3	0	0	6
Minnesota	V	3	1	2	0	0	6
Mississippi	IV	0	0	0	0	0	0
Missouri	VII	1	1	2	0	0	4
Montana	VIII	0	0	0	0	0	0
Nebraska	VII	1	0	0	0	0	1
Nevada	IX	0	0	0	0	0	0
New Hampshire	I	1	0	0	0	1	2
New Jersey	II	9	1	6	1	5	22
New Mexico	VI	0	0	0	0	2	2
New York	II	11	11	11	4	11	48
North Carolina	IV	3	1	0	0	1	5
North Dakota	VIII	0	0	0	0	0	0
Ohio	V	4	1	1	1	1	8
Oklahoma	VI	0	3	0	0	1	4
Oregon	X	1	0	1	0	0	2
Pennsylvania	III	3	4	2	2	1	12
Rhode Island	I	0	0	0	0	1	1
South Carolina	IV	1	0	0	0	3	4
South Dakota	VII	0	0	0	0	0	0
Tennessee	IV	0	0	0	0	0	0
Texas	VI	2	0	0	0	3	5
Utah	VIII	0	0	0	0	0	0
Vermont	I	0	0	0	0	0	0
Virginia	III	2	1	2	0	3	8
Washington	X	3	0	0	0	0	3
West Virginia	III	0	0	0	0	0	0
Wisconsin	V	1	0	0	0	2	3
Wyoming	VIII	0	0	0	0	0	0
National		99	32	63	17	67	298
EPA Region							
I		8	7	9	3	8	35
II		20	12	17	5	16	70
III		6	6	5	2	4	23
IV		14	4	2	1	9	30
V		21	11	18	6	12	68
VI		4	4	0	0	7	15
VII		2	1	3	0	0	6
VIII		0	1	0	0	2	3
IX		20	6	8	0	9	43
X		4	0	1	0	0	5

Note: Totals are different than those in Table , page 36, because of the different data source. Totals are also different than shown in Table , page 42, because Appendix F totals include non-reporting companies and Table totals do not.

*Source: Dun & Bradstreet Listing of 6,900 Manufacturing Establishments, April 1975.

APPENDIX G

PROJECT METHODOLOGY

STATISTICAL DESCRIPTION OF THE INDUSTRY

The first major phase of this study was characterizing the SIC 355 and 357 industries statistically in terms of number of plants and geographic distribution, age and process distribution, distribution by product, and other factors. The methodology utilized for this task is integral to the presentation of the description of the industry in Section II and since it is enunciated there, it is not repreated here. The principal source documents used were the 1967 and 1972 Census of Manufactures. The data provided therein were supplemented by the Dun & Bradstreet Inc. Metalworking Directory for 1974

IDENTIFYING CANDIDATE PLANTS FOR SURVEY

The methodology for the random selection of plants within SIC 355 and 357 as candidates for on-site survey was as follows:

A representative mix of plants in terms of size, geographic location, and products produced was compiled from a computer printout of the sections of the Dun & Bradstreet Inc. Metalworking Directory for 1974 on these two industrial classifications. Among the pertinent factors provided on each plant by this material were:

Name and address of plant
Primary and secondary SIC's
Number of employees
Identification of management personnel
Telephone number
Sales volume
Age of business
Products

Size distribution was based on plants with less than 20 employees and plants with more than 20 employees. Lists were prepared for all four-digit SIC classifications within SIC 355 and 357 which provided product distribution. Geographic location was distributed among the Northeast, Southern, North Central, and Western sections of the country. This terminology, which derived from usage in the Dun & Bradstreed Directory, covered all states and areas of the country.

TRADE ASSOCIATION CONTACTS

Simultaneous with preparation of the above plant lists, trade associations representing plants in SIC 355 and 357 were identified. Sources for this information were contractor knowledge, industrial journals, and the 1974 volume National Trade and Professional Associations of the United States and Labor Unions (Columbia Books, Inc., Washington, D.C.).

Association representatives were first contacted by telephone for two purposes: (1) To acquaint them with the objectives of the on-going study, and (2) to solicit any assistance they might provide to the project. Next, visits were made to Washington, D.C. offices of association representatives to gain first-hand insight into the industries involved, to discuss project requirements in more detail, and to convey EPA requests for their participation in review of the draft final report. Industry directories were obtained both as a result of early telephone calls and personal visits.

PLANT SURVEYS

The next step was arranging on-site surveys. The random selection lists were provided to each survey team which consisted of one individual knowledgeable in the processes of the metal working industries and another conversant with wastes produced and techniques for their disposal. Within the framework of built-in safeguards against overlap, each team undertook to arrange its own surveys.

This proved to be a difficult and timeconsuming effort involving several problems. First of all, telephone contacts with the plants selected at random from the Dun & Bradstreet lists indicated from the outset very severe deficiencies in the Dun & Bradstreet data for purposes of this project. Many calls were made to plants which do not make any of the products which would place them in either SIC 355 and 357 — there were a number of establishments engaged only in printing, for example. Since this fact became apparent in many cases only after a period of time had been used in introducing and explaining the scope of the project, considerable time was lost. In other cases, the plant selected no longer existed or had relocated leaving no change of address.

The second major problem encountered in scheduling plant visits was the fact that many plant officials refused to participate in a survey. Many reasons were given, most of which fell within two broad categories:

1. A large number of government-sponsored surveys had already consumed too much time which was considered unproductive by the plant

personnel; and

2. The plant was too small to afford the personnel time to prepare for a survey.

This development resulted in the fact that random selection was skewed quite early to larger plants. Although some of those visited were quite small in comparison to the largest ones in these industries, they do not adequately represent the smallest plants.

Many plant contacts also advised that theirs was a machine shop operation only and produced very little waste of any kind. It was pointed out that since a purpose of the study was to determine the kinds and amounts of waste disposal areas needed by these industries establishing this fact was of equal value to documenting waste quantities.

The first 19 visits proved their contention to be valid to a large extent in that virtually none of the chemical/heat-using processes with the greatest waste producing potential were found. At that point, a new criterion was established for plant selection — i.e., that they engage in casting, forging, heat treating, electroplating, or other processes more complex than machining and assembly. The difficulties encountered in identifying such plants are described in Section III. In addition to the phone contacts discussed there, an attempt was made to canvass nearly all SIC 355 and 357 establishments in the Los Angeles area, an effort which reached a great many of them. Except for one plant selected in the random process in which scheduling difficulties precluded a survey, none was found in the Los Angeles area which engage in the above processes.

At this juncture, plants were selected which were known to include one or more of the above processes. This move was necessary in order to gather data on the wastes generated by them, but at the same time it skewed waste quantities toward the waste-producing processes.

A standard interview format was used in each plant survey in order to maximize uniformity of data gathered and its presentation. The form is shown at the end of this Appendix. A total of 20 visits were made which resulted from the random selection process, and 13 hand-picked plants were surveyed. In addition, visits were made to the corporation headquarters of two major manufacturers with plants in SIC 355 and 357 to discuss overall company policies and procedures with respect to the treatment and disposal of potentially hazardous wastes.

LABORATORY ANALYSIS OF WASTES

A total of 23 process waste samples from manufacturing plants were collected and analyzed for use in ascertaining the hazardous nature of the various process wastes. As noted in the body of the report, selection of samples was guided by the following criteria:

1. The wastes should be destined for land disposal or incineration.

2. They should be generated in relatively significant quantities by the plant. This was usually defined as more than 190 liters (50 gallons) per year.

3. The wastes should be available for sampling by the survey team.

The methodology of the chemical analyses performed was as follows:

Flash Point

A setaflash Tester (closed cup, range 50-225°F) model OISF was used in all flash point measurements. This instrument has been accepted by the American Society for Testing and Materials (ASTM Method D-3278-73) as well as the U.S. Department of Transportation. All values reported were to the nearest degree Fahrenheit except where no flash was observed (upper limit of detection is 225°F).

Cyanide

Cyanide determinations were made by first distilling an acidified sample into caustic, forming sodium cyanide. The sodium cyanide was converted to cyanogen chloride (CNCl) by reaction with chloramine-T. Pyridine-pyrazolone reagent was then added to react with the cyanogen chloride and form a blue dye which was measured spectrophotometrically at 620 nanometers (nm). (The cyanide present was determined by comparison of this absorbance at 620 nm with standards at known concentrations, treated in the same manner.) Results were reported as mg CN/liter (lower detection limit - 10 mg/l). Reference, Standard Methods for the Examination of Water and Wastewater, 13th Ed., p. 397, Method 207, APHA, AWWA, WPCF, 1971.

Oil and Grease (Hexane Extractables)

The oil and grease content of the sludge samples was determined by first drying a portion (20g) of the sample with magnesium sulfate (monohydrate), followed by grinding into a dry powder. The resulting powder was then extracted in a soxhlet apparatus using 150 ml of hexane as the extracting solvent (four hours at 20 cycles/hour). The solvent, containing the extracted oil and grease, was then evaporated at 45°C in a beaker. After dessicating, the beaker was weighed and the oil and grease (hexane extractable) content calculated and reported as mg/kg.

The oil and grease content of the liquid samples were determined by first acidifying a portion of the sample with HCl to a pH of 1. The solid and/or viscous grease was then separated from the liquid by filtration (Whatman #40 filter paper containing one gram of filter aid). The filter paper, containing the oil and grease, was then extracted as described above for the sludge samples in a soxhlet apparatus using 150 ml of hexane. The oil and grease content was reported as mg/kg as hexane extractable (lower detection limit - 25 mg/l). Reference: Standard Methods for the Examination of Water and Wastewater, 13th Ed., Method 209C, p. 412, Method 209A, p. 409, APHA, AWWA, WPCF, 1971.

Metals (Cd, Cr, Cu, Fe, Pb, and Zn)

Samples for metal analyses were prepared for atomic absorption spectroscopy by two procedures. First, for the water leaching tests, the samples were weighed into 250 ml Erlenmeyer flasks and twice the samples' weight of distilled water was added. The flasks were sealed and placed on a Burrell Model 75 wrist action shaker and agitated for 8 hours. The samples were then centrifuged and filtered through 0.45 micron filters to remove particulate matter. The pH and specific conductance of the filtrates were measured. The filtrates were acidified with HNO_3 and evaporated to dryness on a hot plate. The residues were dissolved with HCl and diluted to a known volume with distilled water. The metals were then determined by atomic absorption spectroscopy as described in Manual of Methods for Chemical Analysis of Water and Wastes, U.S. EPA, 1974.

Second, to obtain the total concentration of metals in the samples themselves, the ignited solids obtained from the percent solids at 550°C were treated with HNO_3 and evaporated to dryness. The residues were leached with HCl and diluted to known volumes with distilled water. The metals were determined as above.

The ranges of detection limits in ppm were as follows:

Cd	0.02 -	0.2
Cr	0.02 -	0.2
Cu	0.06 -	0.2
Fe	0.08 -	1.0
Pb	0.5 -	10.0
Zn	0.02	0.2
Ni	0.1	
Mn	0.04	

Fluoride

The fluoride content was determined by leaching 25 grams of sample with 50 ml of distilled water. After filtering, the filtrate was analyzed for fluoride by adding SPADNS reagent and comparing the spectrophotometrically measured absorbance with standards. The results were reported as leachable fluoride on an mg/kg of sample basis (lower limit of detection - 0.1 mg/kg). Reference: Standard Methods for the Examination of Water and Wastewater, 13th Ed., Method 121C p. 174, APHA, AWWA, WPCF, 1971.

Specific Conductance

The specific conductance of the leachates, obtained from leaching the solids sample as described under the metal analysis description, was determined using a YSI Model 31 Conductivity Bridge. All values were corrected to 25°C and reported in micromhos.

pH

The pH of the liquid sample, as well as the leachates obtained from leaching the solid samples (see metal analysis methodology) was determined using an Analytical Measurements digital pH meter and a combination electrode. All measurements were made at ambient temperature and reported to the nearest 0.1 pH units. The meter was standardized against standard buffer solutions at pH 4, 7, and 10.

Drying Loss of Solids at 103°C

Samples were weighed into tared dishes previously ignited at 550°C. The dishes were placed in a drying oven at 103°C and dried to a constant weight (lower limit of detection 0.01%).

Ignition Loss of Solids at 550°C

The weighed dishes from the drying loss at 103°C were placed in a muffle furnace at 550°C and ignited to a constant weight. The weight loss from 103°C to 550°C was calculated as ignition loss at 550°C (lower limit of detection - 0.01%).

Solids at 550°C

The residue remaining after ignition at 550°C was calculated as solids at 550°C (lower limit of detection - 0.01%). 1970 Annual Book of ASTM Standards, Part 21

Water

Water concentration was determined on the aqueous-organic mixtures using the Karl Fischer Titration with visual end point. The Karl Fischer Titration for water is represented by the simplified equation:

$$(I_2 + SO_2 + CH_3OH + 3\ \text{Pyridine})\ \_\ H_2O \rightarrow$$

(Karl Fischer Reagent)

$$(2\ \text{Pyridine}\ H^+ I^- + \text{Pyridine}\ HOSO_{2}OCH_3)$$

(End Product with H_2O)

Samples were weighed into methanol, which had been titrated free of water, and standard Karl Fischer Reagent was added to a visual end point. Colored iodine is consumed in the reaction with water allowing end point detection (lower limit of detection - 0.2%). Chemical Analysis, H. A. Laitenen, 1960, p. 421 FF.

Trichloroethylene

The trichloroethylene (M.W. 131.4, B.P. 87°C) content of those samples suspected of containing a significant amount was determined according to the following procedure:

1. A mixture containing 33% toluene, 33% methanol, and 33% sample was prepared and distilled. The distillate boiling over at up to 105°C was collected and analyzed by gas chromatography.

2. One microliter of distillate was injected into a Varian series 2800 gas chromatograph, isothermally operated at 70°C, using a flame ionization detector and a 1/4" x 6' stainless steel column packed with 15% Carbowax - TPA on 80/100 Chromosorb W. The chromatograph was operated in conjunction with a strip chart recorder and an Autolab integrator.

3. Calculation of the percent of trichloroethylene in the unknown samples were made by comparison with standard trichloroethylene solutions and the internal methanol standard present in each of the samples distilled.

Results were reported as % trichloroethylene (lower limit of detection - 0.1%). References: Standard Methods for the Examination of Water and Wastewater, 13th Ed., Method 113A p. 100, APHA, AWWA, WPCF, 1971 and H. McNair, E. Bonelli, Basic Gas Chromatography, Consolidated Publishers, California, p. 111, 1967.

APPLICATION OF ANALYTICAL RESULTS

The analytical data plus the results of a literature search were compared to criteria, which were developed by the contractor, to determine which process waste streams were potentially hazardous.

ESTIMATING WASTE QUANTITIES

Estimates of national and state totals of potentially hazardous wastes deriving from SIC 355 and 357 plants were determined on the basis of plant survey and Census of Manufactures data. Two basic factors were taken into account: (1) Waste characteristics are dependent upon the processes used within individual plants; and (2) the quantities of wastes generated by each process will vary according to the size of the process. The major indicators of process size in a plant are dimensions of process area, number of production workers assigned to each process, the amount of material input into the process, and the amount of material output from the process. Figures on the amount of material entering and leaving each process are generally not available. This is because plants usually do not keep records of this information, and, if they do, it is proprietary. The process area square footage is available from the plant survey data, but there is no related information on national or state totals.

Thus, the one indicator upon which both survey and Census data could be correlated was the number of production workers employed in each process. The number reported by surveyed plants and waste quantities reported were used to develop waste generation factors which were then applied to national production employee totals. Estimates for state totals were determined using Census data on production worker distribution by states.

The potentially hazardous wastes and the potentially hazardous waste constituents to be quantified were determined by the laboratory analyses of samples collected on site visits and in accord with the definition of hazardous wastes used in this report.

National and state waste totals were developed using the following expressions:

> National waste quantity = No. of processes used in the industry X average amount of employees per process X average amount of waste per year for each employee.

State waste quantity = National waste quantity X percent of production workers in each state in SIC 355 and 357.

Waste quantities were projected to 1977 and 1983 using Census and U.S. Industrial Outlook statistics to estimate the number of production workers in the industries through 1983. The rise or fall in the number of production workers was distributed among the various unit processes in existing ratios. It was also assumed that process technology will not change drastically between now and 1983. The same waste generation factors in terms of kkg/yr-dept. employee developed for 1975 were applied through 1983, and additional wastes for land disposal created by achievement of "zero pollution discharge" pursuant to the Federal Water Pollution Control Act were taken into account. Based primarily on engineering judgment, it is estimated that the data developed are accurate to ± 30 percent.

The effects of the effluent limitations guidelines to be applied under the Act on 1983 waste quantities for land disposal were calculated as follows:

Basic data on the quantity and quality of the raw waste loads generated by the 11 basic metal working processes covered by this report were provided by EPA's Development Document for Effluent Limitations Guidelines and Standards of Performance for the Machinery and Mechanical Products Point Source Category. Breakdowns by four-digit SIC classifications in terms of the processes utilized and total volume of wastewater discharged annually were set forth although wastewater data were not developed for specific SIC industries. Instead, mean flow quantities and contaminant concentrations for representative raw waste streams were determined. These data were used in conjunction with other available data to quantify the wastes attributable to the 11 four-digit industries within SIC 355 and 357. In order to allocate the total water volume discharged by each industry to each of the processes utilized, a factor representing the ratio of the flow used per process to the sum of the flows for all the applicable processes was employed. The methodology used can be explained by using SIC 3551, Food Products Machinery, as an example.

The above Development Document showed that heat treating, electroplating, forming, machining, coating, and assembly are practiced in 40 to 60 percent of SIC 3551 establishments. The flow data indicated that these processes discharge a mean wastewater volume, MGD, of approximately 0.51, 0.50, 0.41, 0.30, 0.51, and 0.46 respectively. Using these process wastewater flows, each process was allocated the amount of contaminants to be removed based on known waste concentrations which were contained in the Development Document.

The hazardous wastes quantified are cyanides, cadmium, total chromium, lead, mercury, chlorinated hydrocarbons, and oil and grease. Total suspended solids (TSS) were the only nonhazardous waste constituent considered, since most of the solids attributable to BOD are already included in the oil and grease and TSS constituents which make up more than 99 percent of the total quantity of contaminants.

In order to calculate the quantity per year of hazardous, nonhazardous, and total wastes destined for landfill or incineration, the concentrations of hazardous wastes in mg/l were added. Then, the volume of water utilized by process was converted from gallons to pounds, and the total hazardous and nonhazardous wastes concentrations were determined. The pounds per year, dry weight, or wastes generated were totaled and converted to tons per year.

The summary information was developed in this manner for the processes noted above.

ESTABLISHING LEVEL I, II, AND III TREATMENT AND DISPOSAL TECHNOLOGIES

The treatment and disposal practices of these industries were extrapolated from the data on waste disposal practices of surveyed plants. Level I technology, the most prevalent in use for a given waste, was established by tabulating the information provided on current practices. This tabulation indicated Level I very clearly in all cases. Level II, the best technology in use, was almost as clear-cut although some allowance had to be made for the fact that limited plants may achieve a Level II technology which is not possible in others — complete recirculation of coolants, for example.

Level III technology — technology necessary to provide adequate health and environmental protection which may include pilot or bench scale processes — was influenced by the fact that the degree of toxicity of some of the waste materials, and their ultimate environmental effects, have not been clearly established. This led to the specification of secured landfills for the disposal of potentially hazardous wastes rather than sanitary landfills.

ESTIMATING COSTS

Cost data on the treatment and disposal of process wastes from the special machinery and office machine manufacturing industries were derived from information supplied during the 33 survey visits, from the special cost variability study, and from the Snell report on hazardous waste treatment and disposal costs. However, less than

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ESTIMATING COSTS

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Most of the manufacturing establishments in the industry use private contractors for the handling, treatment, and disposal of potentially hazardous wastes. Because of this, the cost estimates for each waste stream reflect off-site hazardous waste management, and do not include breakdowns of the costs borne by the manufacturing establishments. Level III technology is not practiced to a significant degree for any of the process waste streams generated by the industry. Because of this, data and information from other literature sources were used to project costs for Level III treatment and disposal to the special machinery and office machines manufacturing industries.

Typical manufacturing establishments within SIC 355 and 357 were defined in Section III based on plant survey results and data supplied by the Census of Manufactures. Using this information plus the cost data derived for each waste stream, the average annual cost of potentially hazardous waste treatment and disposal using Level I, II, and III technology for typical plants were calculated. Average treatment and disposal costs to the industries as a whole were calculated based on Table II-7 which shows the number of each unit process in the subject industries. Data on the average number of employees per unit process and the average potentially hazardous waste generated per process were used to crudely estimate national costs for each level of technology. No allowance was made for on-site treatment and disposal practices within the industry due to the relatively low percentage of use of such practices.

Based on the variability of hazardous waste management costs, it is anticipated, based on contractor judgment that the data provided are accurate to ± 30 percent.

WAPORA, Inc.
A. T. Kearney, Inc.
Contract No. 68-01-3193

ASSESSMENT OF INDUSTRIAL HAZARDOUS WASTE PRACTICES
SPECIAL INDUSTRIAL MACHINERY MANUFACTURING

Plant Survey Report

I. GENERAL INFORMATION

Company Name ______________________ Date Visited ________

Plant Address ______________________ Zip Code ______

Telephone ____/__________ Survey Team ______________________

Persons Contacted ______________________

EPA Representative Present ______________________

Plant Age ______________ Number of Employees ______________

Last Major Expansion or Modification ______________________

____

PRODUCTION AT THIS LOCATION			
		Production Rate	
Product Made	SIC Code	Number Made/Yr.	Sales/Yr.

COMPANY NAME ______________________________ LOCATION ______________________

II. PROCESS WASTE GENERATION

Manufacturing Process[1]	Typical Products	Types of Processes and Equipment Used
Ferrous Foundry		
Non Ferrous Foundry		
Non Ferrous Die Casting		
Forging		
Electroplating		
Galvanizing		
Heat Treating		
Machine Shop		
Tool and Die Shop		
Plate or Struct. Fabric.		
Stamping, Blanking, Forming		
Painting and Other Coating		
Plastics Molding		
Assembly		
Shipping Department		
Other Operations		

Note: (1) Attach process flow diagram for SIC 355 and 357 products manufactured.

II. PROCESS WASTE GENERATION - Cont'd.

Manufacturing Process(1)	Department Area	No. Employees	Description of Process Waste Streams (2)
Ferrous Foundry			
Non Ferrous Foundry			
Non Ferrous Die Casting			
Forging			
Electroplating			
Galvanizing			
Heat Treating			
Machine Shop			
Tool and Die Shop			
Plate or Struct. Fabric.			
Stamping, Blanking, Forming			
Painting and Other Coating			
Plastics Molding			
Assembly			
Shipping Department			
Other Operations			

Note: (1) Attach process flow diagram for SIC 355 and 357 products manufactured.
(2) Cite potentially hazardous constituents and their usage rates.

II. PROCESS WASTE GENERATION - Cont'd.

Manufacturing Process (1)	Waste Flow Rates	Stream Sampled	Comments
Ferrous Foundry			
Non Ferrous Foundry			
Non Ferrous Die Casting			
Forging			
Electroplating			
Galvanizing			
Heat Treating			
Machine Shop			
Tool and Die Shop			
Plate or Struct. Fabric.			
Stamping, Blanking, Forming			
Painting and Other Coating			
Plastics Molding			
Assembly			
Shipping Department			
Other Operations			

Note: (1) Attach process flow diagram for SIC 355 and 357 products manufactured.

COMPANY NAME ______________________________ LOCATION __________________

III. PROCESS WASTE DISPOSAL METHODS

A. Are potentially hazardous wastes handled or treated differently from other wastes? _____ If yes, explain ______________________________

____

____

B. Are potentially hazardous solid and semi-solid wastes disposed of on-site or off-site? ____________ Disposal methods used ____________________

____

____

C. Disposal method(s) used for water and wastewater treatment sludges ______

____

D. Total quantity of process wastewater generated (excluding cooling water)

____

E. Disposal method(s) used for materials collected by air pollution abatement devices ____

____

F. Disposal methods used for other process waste streams (other than contractor disposal ____

____

____

G. Cost of on-site disposal ____

H. Does a private contractor dispose of any process wastes? ______________

Contractor Name ____

Address ______________________________ Phone No. ________________

Type of Disposal Facility ______________________________________

Approximate Cost of Disposal Service __________________________

Types and Quantities of Wastes Handled from Plant ____________________

____

Method(s) used to store and collect wastes for disposal (containers used, precautions taken both at plant and contractor's site) ________________

____

____

COMPANY NAME ______________________________ LOCATION ________________

IV. FUTURE OPERATION CHANGES

A. Are there any firm plans for changing the use of potentially hazardous materials in your plant? __________ ______________________________

____

____

B. Are there any firm plans for changes in process waste disposal methods?

____

____

____

APPENDIX H

CHEMICAL/PHYSICAL PROPERTIES OF SELECTED RAW MATERIALS

Molecular Weight	Chemical Name	Common Name	Formula	Appearance	Industrial Use	Specific Gravity	Boiling Point °C	Melting Point °C	Water Solubility g/100g	Alcohol Solubility g/100g	Flash Point °C	Gleason* Toxicity Rating	Threshold Limit Value mg/m³ Air
131.39	1,1,2-Trichloro ethene	Trichloroethylene (TCE)	$CCl_2{:}CHCl$	Clear Liquid	Degreaser	1.46	87	-73	Insoluble		No Flash	4	535
133.41	1,1,1-Trichloroethane	Methyl Chloroform	CH_3CCl_3	Clear Liquid	Solvent	1.34	74	-30	Insoluble		No Flash	3	1900
133.41	1,1,2-Trichloroethane	B-Trichloroethane	$CH_2ClCHCl_3$	Clear Liquid	Solvent	1.44	114	-36	Slightly Soluble	Soluble	--	4	45
94.11	Phenol	Carbolic Acid	C_6H_5OH	Colorless Rhomic Needles	Solvent	1.07	182	41	Soluble	Soluble	79.5	4	19
46.07	Ethanol	Methyl Carbinol	CH_3CH_2OH	Liquid	Solvent	0.79	78.5	-117			18	2	1900
60.11	2-Propanol	Isopropyl Alcohol (IPA)	$CH_3CH(OH)CH_3$	Liquid	Solvent	0.79	82.4	-89.5			11.7	3	980
92.15	Toluene	Methyl Benzene	$C_6H_5CH_3$	Liquid	Solvent	0.87	110	-95	Insoluble		4.5	4	375
72.12	2-Butanone	Methyl Ethyl Ketone	$CH_3COCH_2CH_3$	Liquid	Solvent	0.81	79.6	-86	Very Soluble		2.2	3	590
58.08	2-Propanone	Acetone	CH_3COCH_3	Liquid	Solvent	0.79	56.1	-94.6	Miscible	Miscible	-18	3	2400
	VM & P Naphtha	Naphtha	Paraffins 48% Naphthalenes 42%	Liquid	Paint Thinner	0.75	120-140	—	Insoluble	Miscible	13	3	
165.83	Perchloroethylene	Perchlor	$Cl_2C{:}CCl_2$	Liquid	Solvent	1.62	121	-19	Insoluble				
—	Stoddard Solvent		Paraffins 65% Naphthalenes 21%	Liquid	Solvent	0.77	155-197	—	Insoluble	—	40		
--	Mineral Spirits	Mineral Spirits	Paraffins 61% Naphthalenes 39%	Liquid	Solvents	0.74-0.76	150-190	—	Insoluble	—	40	3	
98.08	Sulfuric Acid	Oil of Vitriol	H_2SO_4	Colorless Oily Liquid	Pickling	1.84	330 Decomposes	10.5		Decomposes			1

---

* See Reference 16.

Appendix H - Cont'd.

Molecular Weight	Chemical Name	Common Name	Formula	Appearance	Industrial Use	Specific Gravity	Boiling Point °C	Melting Point °C	Water Solubility g/100g	Alcohol Solubility g/100g	Flash Point °C	Gleason* Toxicity Rating	Threshold Limit Value mg/m³ Air
100.01	Chromium Trioxide	Chromic Acid	CrO_3	Red Deliquescent Rhombic	Metal Plating & Acid Cleaner	2.70	Decomposes	196	62	Soluble		4	0.1
36.47	Hydrochloric Acid	Muriatic Acid	Constant Boiling 20.24% + 79.76% $HCl+H_2O$	Colorless Liquid	Pickling		110			Soluble			7
63.02	Nitric Acid	Azotic Acid	HNO_3	Colorless Liquid	Pickling	1.50	83	-42		Decomposes Violently			5
20.01	Hydrofluoric Acid	Hydrogen Fluoride	Constant Boiling 35.35% + 64.65% $HF+H_2O$	Colorless Liquid	Pickling		120			Soluble			2
192.12	Citric Acid		$C_6H_8O_7$	Colorless Rhombic	Acid Cleaner	1.54	Decomposes	153	133	116			
196.16	D-Gluconic	Dextronic Acid	$C_6H_{12}O_7$	Crystalline	Acid Cleaner			125-6	Soluble	Insoluble			
126.07	Oxalic Acid	Ethanedioic Acid	$C_2H_2O_4 \cdot 2H_2O$	Colorless Monoclinic	Acid Cleaner	1.65	150 Sublimes	101	9.5	23.7			1
60.05	Acetic Acid	Vinegar Acid	$C_2H_4O_2$	Colorless Liquid	Acid Cleaner	1.05	118.1	16.6			43		25
150.09	D-Tartaric Acid		$C_4H_6O_6$	White Crystals	Acid Cleaner	1.76		168-170	139	19.9	210		
56.11	Potassium Hydroxide	Potassium Hydrate	KOH	White Rhombic	Alkaline Cleaner	2.04	1322	360	97	Very Soluble			2
40.01	Sodium Hydroxide	Caustic Soda	NaOH	White	Alkaline Cleaner	2.13	1390	318	42	Very Soluble			2
12.01	Carbon	Graphite	C	Iron Black	Lubricant	2.09-2.23	4827	3652-3699	Insoluble	Insoluble	—	-	15(million particles per cu.ft)
154.76	Nickel Sulfate	Nickel Salt	$NiSO_4$	Yellow Cu-Cubic Crystals	Metal Plating	3.68		848	29	Insoluble	—	4	
232.00	Cupric Chloride-Basic		$CuCl_2 \cdot Cu(OH)_2$	Yellow Green Hexagonal	Etchant	3.78	Decomposes at Red Heat	$-H_2O$ at 250	Decomposes	—	—	4	1 (as Cu fume,dust, or mist)
223.13	Copper (I) Sulfate	Cuprous Sulfate	Cu_2SO_4	Gray Powder	Metal Plating	3.61		200	Decomposes	—	—	4	1 (as Cu fume,dust, or mist)

Appendix H - Cont'd.

Molecular Weight	Chemical Name	Common Name	Formula	Appearance	Industrial Use	Specific Gravity	Boiling Point °C	Melting Point °C	Water Solubility g/100g	Alcohol Solubility g/100g	Flash Point °C	Gleason* Toxicity Rating	Threshold Limit Value mg/m³ Air
159.60	Copper II Sulfate	Cupric Sulfate	$CuSO_4$	Green-White Crystals	Metal Plating	3.60	Decomposes to CuO,650	Slowly Decomposes 200	14	$1^{(CH_3OH)}$	—	4	1 (as Cu fume,dust, or mist)
89.56	Copper (I) Cyanide	Cuprous Cyanide	CuCN	White Monoclinic	Metal Plating	2.92	Decomposes	473	Insoluble	—	—	6	5 (as CN^-)
115.58	Copper (II) Cyanide	Cupric Cyanide	$Cu(CN)_2$	Yellow-Green Powder	Metal Plating	—		Decomposes	Insoluble	—	—	6	1 (as CU fume,dust, or mist)
161.97	Sodium Chromate	Chromium Salt	Na_2CrO_4	Yellow Rhombic	Metal Plating	2.72	--	—	87.3	Slightly Soluble	—	4	0.5
128.40	Cadmium Oxide		CdO	Amorphic or Cubic and Brown	Metal Plating	6.95-8.15	Decomposes 900	Sublimes 1559	Insoluble	—	—	5	0.05 (as Cd)
208.46	Cadmium Sulfate	Cadmium Salt	$CdSO_4$	White Rhombic	Metal Plating	4.96	—	1000	75	Insoluble	—	5	0.05 (as Cd)
169.87	Silver Nitrate	Silver Salt	$AgNO_3$	Colorless Rhombic	Metal Plating	4.35	444 Decomposes	212	122	Very Slightly Soluble	—	4	0.01
26.98	Aluminum	--	Al	Silver, White, Ductile, Cubic	Machine Parts	2.70	2467	660	Insoluble	Insoluble	—		
303.33	Auric Chloride	Gold Trichloride	$AuCl_3$	Claret-Red Crystals	Metal Plating	3.9	Sublimes 265	Decompose 254	68	Soluble	—	4	
74.92	Arsenic	--	As	Gray Metal	Metal Plating	5.73	Sublimes 613	814 at 36 atm	Insoluble	—	—	5	0.5(as As)
136.28	Zinc Chloride	Zinc Salt	$ZnCl_2$	White Hexagonal	Metal Plating	2.91	732	283	432	100	—	4	1 ($ZnCl_2$ fumes)
161.43	Zinc Sulfate	Zinkosite	$ZnSO_4$	Colorless Rhombic	Metal Plating	3.54	—	Decomposes 600	Soluble	Slightly Soluble	--	4	
150.69	Tin (IV) Oxide	Stannic Oxide	SnO_2	White Tetrahedral	Metal Plating	6.95	Sublimes 1800-1900	1127	Insoluble	Insoluble	--	—	10 (as SnO_2)
189.60	Tin (II) Chloride	Stannous Chloride	$SnCl_2$	White Rhombic	Metal Plating	3.95	652	246	84	Soluble	--	—	2(as Sn)
228.18	Ammonium Peroxydisulfate	Ammonium Persulfate	$(NH_4)_2S_2O_8$	Colorless Monoclinic	Acid Cleaner	1.98	—	Decomposes 120	58.2	--	—		
105.99	Sodium Carbonate	Soda Monohydrate	Na_2CO_3	White Hygroscopic Powder	Alkaline Cleaner	2.53	Decomposes	851	7	Slightly Soluble	—		

Appendix H - Cont'd.

Molecular Weight	Chemical Name	Common Name	Formula	Appearance	Industrial Use	Specific Gravity	Boiling Point °C	Melting Point °C	Water Solubility g/100g	Alcohol Solubility g/100g	Flash Point °C	Gleason* Toxicity Rating	Threshold Limit Value mg/M^3 Air
611.17	Sodium Hexametaphosphate	Graham's Salt	$(NaPO_3)_6$	Colorless Glass	Cleaning Agent	—	—	--	Very Soluble	—	—	2	
61.99	Sodium Hydrogen Fluoride		NaF.HF	Colorless, White, Crystalline, Powder	Acid Cleaner	2.08	--	—	Soluble	—	—	4	2.5
120.1'	Sodium Hydrogen Sulfate	Sodium Acid Sulfate	$NaHSO_4$	Colorless Crystals	Acid Cleaner	2.44	Decomposes	Over 315	28.6	Slightly Soluble	--	See Sulfuric Acid	
81.07	Sodium Thiocyanate		NaSCN	Colorless Rhombic		—	—	287	139	Very Soluble	—	4	
49.01	Sodium Cyanide		NaCN	Colorless Cubic	Heat Treating & Electroplating		1496	563.7	48	Slightly Soluble	--	6	5
58.44	Sodium Chloride	Natural Halite	NaCl	Colorless Cubic	Heat Treating Salt Bath	2.17	1413	801	35.7	Slightly Soluble	—	3	
74.56	Potassium Chloride	Natural Sylvite	KCl	Colorless Cubic	Heat Treating Salt Bath	1.98	Sublimes 1500	776	34.7	Slightly Soluble			
102.91	Rhodium		Rh	Gray-White Cubic	Metal Plating	12.4	3727±100	1966±3	Insoluble	--	--	--	0.1
209.26	Rhodium Chloride		$RhCl_3$	Brick-Red Powder	Metal Plating	—	Sublimes 800	Decomposes 450-500	Insoluble	—	—	—	0.01
60.08	Silicon Dioxide	Sand	SiO_2	Colorless Cubic	Abrasive	2.2	2230	1713±5	Insoluble	Insoluble		1	20(million particles per cu.ft)

APPENDIX I

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING (SIC 355) PROCESS WASTE GENERATION FOR 1975, 1977, AND 1983 BY STATE AND EPA REGION

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — MACHINE SHOP
1975 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	746.	481.	746.	481.	174.	28.8	11.4	0.	0.	260.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	210.	136.	210.	136.	49.	8.1	3.2	0.	0.	73.
ARKANSAS	VI	199.	128.	199.	128.	46.	7.7	3.0	0.	0.	69.
CALIFORNIA	IX	4743.	3056.	4743.	3056.	1107.	183.2	72.2	0.	0.	1653.
COLORADO	VIII	101.	65.	101.	65.	24.	3.9	1.5	0.	0.	35.
CONNECTICUT	I	2246.	1447.	2246.	1447.	524.	86.8	34.2	0.	0.	783.
DELAWARE	III	349.	225.	349.	225.	82.	13.5	5.3	0.	0.	122.
FLORIDA	IV	1217.	784.	1217.	784.	284.	47.0	18.5	0.	0.	424.
GEORGIA	IV	1417.	913.	1417.	913.	331.	54.8	21.6	0.	0.	494.
HAWAII	IX	32.	20.	32.	20.	7.	1.2	.5	0.	0.	11.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	6299.	4058.	6299.	4058.	1470.	243.3	95.8	0.	0.	2195.
INDIANA	V	2341.	1508.	2341.	1508.	546.	90.4	35.6	0.	0.	816.
IOWA	VII	933.	601.	933.	601.	218.	36.1	14.2	0.	0.	325.
KANSAS	VII	688.	443.	688.	443.	161.	26.6	10.5	0.	0.	240.
KENTUCKY	IV	541.	348.	541.	348.	126.	20.9	8.2	0.	0.	189.
LOUISIANA	VI	369.	238.	369.	238.	86.	14.3	5.6	0.	0.	129.
MAINE	I	278.	179.	278.	179.	65.	10.7	4.2	0.	0.	97.
MARYLAND	III	1290.	831.	1290.	831.	301.	49.8	19.6	0.	0.	449.
MASSACHUSETTS	I	6882.	4434.	6882.	4434.	1606.	265.9	104.7	0.	0.	2399.
MICHIGAN	V	2568.	1655.	2568.	1655.	599.	99.2	39.1	0.	0.	895.
MINNESOTA	V	687.	443.	687.	443.	160.	26.6	10.5	0.	0.	240.
MISSISSIPPI	IV	372.	240.	372.	240.	87.	14.4	5.7	0.	0.	130.
MISSOURI	VII	516.	333.	516.	333.	121.	19.9	7.9	0.	0.	180.
MONTANA	VIII	31.	20.	31.	20.	7.	1.2	.5	0.	0.	11.
NEBRASKA	VII	83.	54.	83.	54.	19.	3.2	1.3	0.	0.	29.
NEVADA	IX	32.	20.	32.	20.	7.	1.2	.5	0.	0.	11.
NEW HAMPSHIRE	I	600.	386.	600.	386.	140.	23.2	9.1	0.	0.	209.
NEW JERSEY	II	4712.	3036.	4712.	3036.	1100.	182.0	71.7	0.	0.	1642.
NEW MEXICO	VI	32.	20.	32.	20.	7.	1.2	.5	0.	0.	11.
NEW YORK	II	4542.	2927.	4542.	2927.	1060.	175.5	69.1	0.	0.	1583.
NORTH CAROLINA	IV	4497.	2898.	4497.	2898.	1050.	173.7	68.4	0.	0.	1568.
NORTH DAKOTA	VIII	55.	35.	55.	35.	13.	2.1	.8	0.	0.	19.
OHIO	V	7886.	5081.	7886.	5081.	1841.	304.6	120.0	0.	0.	2749.
OKLAHOMA	VI	696.	449.	696.	449.	163.	26.9	10.6	0.	0.	243.
OREGON	X	870.	561.	870.	561.	203.	33.6	13.2	0.	0.	303.
PENNSYLVANIA	III	6342.	4086.	6342.	4086.	1480.	245.0	96.5	0.	0.	2210.
RHODE ISLAND	I	1621.	1045.	1621.	1045.	378.	62.6	24.7	0.	0.	565.
SOUTH CAROLINA	IV	3294.	2122.	3294.	2122.	769.	127.2	50.1	0.	0.	1148.
SOUTH DAKOTA	VIII	55.	35.	55.	35.	13.	2.1	.8	0.	0.	19.
TENNESSEE	IV	1037.	668.	1037.	668.	242.	40.1	15.8	0.	0.	362.
TEXAS	VI	1474.	950.	1474.	950.	344.	57.0	22.4	0.	0.	514.
UTAH	VIII	32.	20.	32.	20.	7.	1.2	.5	0.	0.	11.
VERMONT	I	350.	226.	350.	226.	82.	13.5	5.3	0.	0.	122.
VIRGINIA	III	662.	427.	662.	427.	155.	25.6	10.1	0.	0.	231.
WASHINGTON	X	1397.	900.	1397.	900.	326.	54.0	21.3	0.	0.	487.
WEST VIRGINIA	III	176.	114.	176.	114.	41.	6.8	2.7	0.	0.	61.
WISCONSIN	V	3408.	2196.	3408.	2196.	795.	131.7	51.9	0.	0.	1188.
WYOMING	VIII	96.	62.	96.	62.	22.	3.7	1.5	0.	0.	34.
TOTALS		79000.	50900.	79000.	50900.	18440.	3052.0	1202.0	0.	0.	27535.
REGION I		11977.	7717.	11977.	7717.	2796.	462.7	182.2	0.	0.	4175.
II		9254.	5962.	9254.	5962.	2160.	357.5	140.8	0.	0.	3225.
III		8819.	5682.	8819.	5682.	2059.	340.7	134.2	0.	0.	3074.
IV		13121.	8454.	13121.	8454.	3063.	506.9	199.6	0.	0.	4573.
V		23185.	14938.	23185.	14938.	5412.	895.7	352.8	0.	0.	8081.
VI		2782.	1792.	2782.	1792.	649.	107.5	42.3	0.	0.	970.
VII		2224.	1433.	2224.	1433.	519.	85.9	33.8	0.	0.	775.
VIII		366.	236.	366.	236.	85.	14.1	5.6	0.	0.	128.
IX		5005.	3224.	5005.	3224.	1168.	193.3	76.1	0.	0.	1744.
X		2267.	1460.	2267.	1460.	529.	87.6	34.5	0.	0.	790.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — HEAT TREATING
1975 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	**EPA Region**	**(Wet Wt.)**	**(Dry Wt.)**	**(Wet Wt.)**	**(Dry Wt.)**	**Flammable Solvents**	**Heavy Metals**	**Oils**	**Acids/Alkali Solution**	**Cyanide**	**Sweepings & Grindings**
ALABAMA	IV	78.	34.	78.	34.	0.	0.	29.7	2.0	.8	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	22.	10.	22.	10.	0.	0.	8.4	.6	.2	0.
ARKANSAS	VI	21.	9.	21.	9.	0.	0.	7.9	.5	.2	0.
CALIFORNIA	IX	498.	219.	498.	219.	0.	0.	188.6	12.4	5.3	0.
COLORADO	VIII	11.	5.	11.	5.	0.	0.	4.0	.3	.1	0.
CONNECTICUT	I	236.	104.	236.	104.	0.	0.	89.3	5.9	2.5	0.
DELAWARE	III	37.	16.	37.	16.	0.	0.	13.9	.9	.4	0.
FLORIDA	IV	128.	56.	128.	56.	0.	0.	48.4	3.2	1.4	0.
GEORGIA	IV	149.	65.	149.	65.	0.	0.	56.4	3.7	1.6	0.
HAWAII	IX	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	662.	291.	662.	291.	0.	0.	250.5	16.5	7.0	0.
INDIANA	V	246.	108.	246.	108.	0.	0.	93.1	6.1	2.6	0.
IOWA	VII	98.	43.	98.	43.	0.	0.	37.1	2.4	1.0	0.
KANSAS	VII	72.	32.	72.	32.	0.	0.	27.4	1.8	.8	0.
KENTUCKY	IV	57.	25.	57.	25.	0.	0.	21.5	1.4	.6	0.
LOUISIANA	VI	39.	17.	39.	17.	0.	0.	14.7	1.0	.4	0.
MAINE	I	29.	13.	29.	13.	0.	0.	11.0	.7	.3	0.
MARYLAND	III	135.	60.	135.	60.	0.	0.	51.3	3.4	1.4	0.
MASSACHUSETTS	I	723.	318.	723.	318.	0.	0.	273.7	18.0	7.7	0.
MICHIGAN	V	270.	119.	270.	119.	0.	0.	102.1	6.7	2.9	0.
MINNESOTA	V	72.	32.	72.	32.	0.	0.	27.3	1.8	.8	0.
MISSISSIPPI	IV	39.	17.	39.	17.	0.	0.	14.8	1.0	.4	0.
MISSOURI	VII	54.	24.	54.	24.	0.	0.	20.5	1.4	.6	0.
MONTANA	VIII	3.	1.	3.	1.	0.	0.	1.2	.1	.0	0.
NEBRASKA	VII	9.	4.	9.	4.	0.	0.	3.3	.2	.1	0.
NEVADA	IX	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
NEW HAMPSHIRE	I	63.	28.	63.	28.	0.	0.	23.8	1.6	.7	0.
NEW JERSEY	II	495.	218.	495.	218.	0.	0.	187.4	12.3	5.2	0.
NEW MEXICO	VI	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
NEW YORK	II	477.	210.	477.	210.	0.	0.	180.7	11.9	5.1	0.
NORTH CAROLINA	IV	472.	208.	472.	208.	0.	0.	178.9	11.8	5.0	0.
NORTH DAKOTA	VIII	6.	3.	6.	3.	0.	0.	2.2	.1	.1	0.
OHIO	V	829.	364.	829.	364.	0.	0.	313.6	20.7	8.8	0.
OKLAHOMA	VI	73.	32.	73.	32.	0.	0.	27.7	1.8	.8	0.
OREGON	X	91.	40.	91.	40.	0.	0.	34.6	2.3	1.0	0.
PENNSYLVANIA	III	666.	293.	666.	293.	0.	0.	252.2	16.6	7.1	0.
RHODE ISLAND	I	170.	75.	170.	75.	0.	0.	64.5	4.2	1.8	0.
SOUTH CAROLINA	IV	346.	152.	346.	152.	0.	0.	131.0	8.6	3.7	0.
SOUTH DAKOTA	VIII	6.	3.	6.	3.	0.	0.	2.2	.1	.1	0.
TENNESSEE	IV	109.	48.	109.	48.	0.	0.	41.3	2.7	1.2	0.
TEXAS	VI	155.	68.	155.	68.	0.	0.	58.6	3.9	1.6	0.
UTAH	VIII	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
VERMONT	I	37.	16.	37.	16.	0.	0.	13.9	.9	.4	0.
VIRGINIA	III	70.	31.	70.	31.	0.	0.	26.3	1.7	.7	0.
WASHINGTON	X	147.	65.	147.	65.	0.	0.	55.5	3.7	1.6	0.
WEST VIRGINIA	III	19.	8.	19.	8.	0.	0.	7.0	.5	.2	0.
WISCONSIN	V	358.	157.	358.	157.	0.	0.	135.5	8.9	3.8	0.
WYOMING	VIII	10.	4.	10.	4.	0.	0.	3.8	.3	.1	0.
TOTALS		8300.	3650.	8300.	3650.	0.	0.	3142.0	207.0	88.0	0.
REGION I		1258.	553.	1258.	553.	0.	0.	476.4	31.4	13.3	0.
II		972.	428.	972.	428.	0.	0.	368.1	24.2	10.3	0.
III		927.	407.	927.	407.	0.	0.	350.8	23.1	9.8	0.
IV		1379.	606.	1379.	606.	0.	0.	521.9	34.4	14.6	0.
V		2436.	1071.	2436.	1071.	0.	0.	922.1	60.8	25.8	0.
VI		292.	129.	292.	129.	0.	0.	110.6	7.3	3.1	0.
VII		234.	103.	234.	103.	0.	0.	88.5	5.8	2.5	0.
VIII		38.	17.	38.	17.	0.	0.	14.6	1.0	.4	0.
IX		526.	231.	526.	231.	0.	0.	199.0	13.1	5.6	0.
X		238.	105.	238.	105.	0.	0.	90.2	5.9	2.5	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — ELECTROPLATING
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.): Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	35.	14.	35.	14.	6.	.3	.3	.7	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	10.	4.	10.	4.	2.	.1	.1	.2	0.	0.
ARKANSAS	VI	9.	4.	9.	4.	2.	.1	.1	.2	0.	0.
CALIFORNIA	IX	222.	90.	222.	90.	41.	1.7	1.7	4.3	0.	0.
COLORADO	VIII	5.	2.	5.	2.	1.	.0	.0	.1	0.	0.
CONNECTICUT	I	105.	43.	105.	43.	19.	.8	.8	2.0	0.	0.
DELAWARE	III	16.	7.	16.	7.	3.	.1	.1	.3	0.	0.
FLORIDA	IV	57.	23.	57.	23.	10.	.4	.4	1.1	0.	0.
GEORGIA	IV	66.	27.	66.	27.	12.	.5	.5	1.3	0.	0.
HAWAII	IX	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	295.	120.	295.	120.	54.	2.3	2.2	5.7	0.	0.
INDIANA	V	110.	44.	110.	44.	20.	.9	.8	2.1	0.	0.
IOWA	VII	44.	18.	44.	18.	8.	.3	.3	.9	0.	0.
KANSAS	VII	32.	13.	32.	13.	6.	.3	.2	.6	0.	0.
KENTUCKY	IV	25.	10.	25.	10.	5.	.2	.2	.5	0.	0.
LOUISIANA	VI	17.	7.	17.	7.	3.	.1	.1	.3	0.	0.
MAINE	I	13.	5.	13.	5.	2.	.1	.1	.3	0.	0.
MARYLAND	III	60.	24.	60.	24.	11.	.5	.5	1.2	0.	0.
MASSACHUSETTS	I	322.	131.	322.	131.	59.	2.5	2.4	6.3	0.	0.
MICHIGAN	V	120.	49.	120.	49.	22.	.9	.9	2.3	0.	0.
MINNESOTA	V	32.	13.	32.	13.	6.	.3	.2	.6	0.	0.
MISSISSIPPI	IV	17.	7.	17.	7.	3.	.1	.1	.3	0.	0.
MISSOURI	VII	24.	10.	24.	10.	4.	.2	.2	.5	0.	0.
MONTANA	VIII	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
NEBRASKA	VII	4.	2.	4.	2.	1.	.0	.0	.1	0.	0.
NEVADA	IX	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
NEW HAMPSHIRE	I	28.	11.	28.	11.	5.	.2	.2	.5	0.	0.
NEW JERSEY	II	221.	89.	221.	89.	41.	1.7	1.7	4.3	0.	0.
NEW MEXICO	VI	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
NEW YORK	II	213.	86.	213.	86.	39.	1.7	1.6	4.1	0.	0.
NORTH CAROLINA	IV	211.	85.	211.	85.	39.	1.7	1.6	4.1	0.	0.
NORTH DAKOTA	VIII	3.	1.	3.	1.	0.	.0	.0	.0	0.	0.
OHIO	V	369.	150.	369.	150.	68.	2.9	2.8	7.2	0.	0.
OKLAHOMA	VI	33.	13.	33.	13.	6.	.3	.2	.6	0.	0.
OREGON	X	41.	17.	41.	17.	7.	.3	.3	.8	0.	0.
PENNSYLVANIA	III	297.	120.	297.	120.	55.	2.3	2.2	5.8	0.	0.
RHODE ISLAND	I	76.	31.	76.	31.	14.	.6	.6	1.5	0.	0.
SOUTH CAROLINA	IV	154.	63.	154.	63.	28.	1.2	1.2	3.0	0.	0.
SOUTH DAKOTA	VIII	3.	1.	3.	1.	0.	.0	.0	.0	0.	0.
TENNESSEE	IV	49.	20.	49.	20.	9.	.4	.4	.9	0.	0.
TEXAS	VI	69.	28.	69.	28.	13.	.5	.5	1.3	0.	0.
UTAH	VIII	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
VERMONT	I	16.	7.	16.	7.	3.	.1	.1	.3	0.	0.
VIRGINIA	III	31.	13.	31.	13.	6.	.2	.2	.6	0.	0.
WASHINGTON	X	65.	27.	65.	27.	12.	.5	.5	1.3	0.	0.
WEST VIRGINIA	III	8.	3.	8.	3.	2.	.1	.1	.2	0.	0.
WISCONSIN	V	160.	65.	160.	65.	29.	1.3	1.2	3.1	0.	0.
WYOMING	VIII	5.	2.	5.	2.	1.	.0	.0	.1	0.	0.
TOTALS		3700.	1500.	3700.	1500.	680.	29.0	28.0	72.0	0.	0.
REGION I		561.	227.	561.	227.	103.	4.4	4.2	10.9	0.	0.
II		433.	176.	433.	176.	80.	3.4	3.3	8.4	0.	0.
III		413.	167.	413.	167.	76.	3.2	3.1	8.0	0.	0.
IV		615.	249.	615.	249.	113.	4.8	4.7	12.0	0.	0.
V		1086.	440.	1086.	440.	200.	8.5	8.2	21.1	0.	0.
VI		130.	53.	130.	53.	24.	1.0	1.0	2.5	0.	0.
VII		104.	42.	104.	42.	19.	.8	.8	2.0	0.	0.
VIII		17.	7.	17.	7.	3.	.1	.1	.3	0.	0.
IX		234.	95.	234.	95.	43.	1.8	1.8	4.6	0.	0.
X		106.	43.	106.	43.	20.	.8	.8	2.1	0.	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — COATING
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	94.	73.	94.	73.	55.	7.0	.1	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	27.	21.	27.	21.	15.	2.0	.0	0.	0.	0.
ARKANSAS	VI	25.	19.	25.	19.	15.	1.9	.0	0.	0.	0.
CALIFORNIA	IX	600.	462.	600.	462.	348.	44.3	.8	0.	0.	0.
COLORADO	VIII	13.	10.	13.	10.	7.	.9	.0	0.	0.	0.
CONNECTICUT	I	284.	219.	284.	219.	165.	21.0	.4	0.	0.	0.
DELAWARE	III	44.	34.	44.	34.	26.	3.3	.1	0.	0.	0.
FLORIDA	IV	154.	119.	154.	119.	89.	11.4	.2	0.	0.	0.
GEORGIA	IV	179.	138.	179.	138.	104.	13.2	.3	0.	0.	0.
HAWAII	IX	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	797.	614.	797.	614.	462.	58.8	1.1	0.	0.	0.
INDIANA	V	296.	228.	296.	228.	172.	21.9	.4	0.	0.	0.
IOWA	VII	118.	91.	118.	91.	69.	8.7	.2	0.	0.	0.
KANSAS	VII	87.	67.	87.	67.	51.	6.4	.1	0.	0.	0.
KENTUCKY	IV	68.	53.	68.	53.	40.	5.1	.1	0.	0.	0.
LOUISIANA	VI	47.	36.	47.	36.	27.	3.4	.1	0.	0.	0.
MAINE	I	35.	27.	35.	27.	20.	2.6	.0	0.	0.	0.
MARYLAND	III	163.	126.	163.	126.	95.	12.0	.2	0.	0.	0.
MASSACHUSETTS	I	871.	671.	871.	671.	505.	64.3	1.2	0.	0.	0.
MICHIGAN	V	325.	250.	325.	250.	189.	24.0	.5	0.	0.	0.
MINNESOTA	V	87.	67.	87.	67.	50.	6.4	.1	0.	0.	0.
MISSISSIPPI	IV	47.	36.	47.	36.	27.	3.5	.1	0.	0.	0.
MISSOURI	VII	65.	50.	65.	50.	38.	4.8	.1	0.	0.	0.
MONTANA	VIII	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
NEBRASKA	VII	11.	8.	11.	8.	6.	.8	.0	0.	0.	0.
NEVADA	IX	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
NEW HAMPSHIRE	I	76.	58.	76.	58.	44.	5.6	.1	0.	0.	0.
NEW JERSEY	II	596.	459.	596.	459.	346.	44.0	.8	0.	0.	0.
NEW MEXICO	VI	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
NEW YORK	II	575.	443.	575.	443.	333.	42.4	.8	0.	0.	0.
NORTH CAROLINA	IV	569.	438.	569.	438.	330.	42.0	.8	0.	0.	0.
NORTH DAKOTA	VIII	7.	5.	7.	5.	4.	.5	.0	0.	0.	0.
OHIO	V	998.	769.	998.	769.	579.	73.7	1.4	0.	0.	0.
OKLAHOMA	VI	88.	68.	88.	68.	51.	6.5	.1	0.	0.	0.
OREGON	X	110.	85.	110.	85.	64.	8.1	.2	0.	0.	0.
PENNSYLVANIA	III	803.	618.	803.	618.	466.	59.2	1.1	0.	0.	0.
RHODE ISLAND	I	205.	158.	205.	158.	119.	15.1	.3	0.	0.	0.
SOUTH CAROLINA	IV	417.	321.	417.	321.	242.	30.8	.6	0.	0.	0.
SOUTH DAKOTA	VIII	7.	5.	7.	5.	4.	.5	.0	0.	0.	0.
TENNESSEE	IV	131.	101.	131.	101.	76.	9.7	.2	0.	0.	0.
TEXAS	VI	187.	144.	187.	144.	108.	13.8	.3	0.	0.	0.
UTAH	VIII	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
VERMONT	I	44.	34.	44.	34.	26.	3.3	.1	0.	0.	0.
VIRGINIA	III	84.	65.	84.	65.	49.	6.2	.1	0.	0.	0.
WASHINGTON	X	177.	136.	177.	136.	103.	13.0	.2	0.	0.	0.
WEST VIRGINIA	III	22.	17.	22.	17.	13.	1.6	.0	0.	0.	0.
WISCONSIN	V	431.	332.	431.	332.	250.	31.8	.6	0.	0.	0.
WYOMING	VIII	12.	9.	12.	9.	7.	.9	.0	0.	0.	0.
TOTALS		10000.	7700.	10000.	7700.	5800.	738.0	14.0	0.	0.	0.
REGION I		1516.	1167.	1516.	1167.	879.	111.9	2.1	0.	0.	0.
II		1171.	902.	1171.	902.	679.	86.4	1.6	0.	0.	0.
III		1116.	860.	1116.	860.	647.	82.4	1.6	0.	0.	0.
IV		1661.	1279.	1661.	1279.	963.	122.6	2.3	0.	0.	0.
V		2935.	2260.	2935.	2260.	1702.	216.6	4.1	0.	0.	0.
VI		352.	271.	352.	271.	204.	26.0	.5	0.	0.	0.
VII		282.	217.	282.	217.	163.	20.8	.4	0.	0.	0.
VIII		46.	36.	46.	36.	27.	3.4	.1	0.	0.	0.
IX		633.	488.	633.	488.	367.	46.8	.9	0.	0.	0.
X		287.	221.	287.	221.	166.	21.2	.4	0.	0.	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — FERROUS AND NONFERROUS FOUNDRY
1975 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	**EPA Region**	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	1634.	1634.	0.	0.	0.	0.	0.	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	461.	461.	0.	0.	0.	0.	0.	0.	0.	0.
ARKANSAS	VI	435.	435.	0.	0.	0.	0.	0.	0.	0.	0.
CALIFORNIA	IX	10386.	10386.	0.	0.	0.	0.	0.	0.	0.	0.
COLORADO	VIII	220.	220.	0.	0.	0.	0.	0.	0.	0.	0.
CONNECTICUT	I	4919.	4919.	0.	0.	0.	0.	0.	0.	0.	0.
DELAWARE	III	765.	765.	0.	0.	0.	0.	0.	0.	0.	0.
FLORIDA	IV	2666.	2666.	0.	0.	0.	0.	0.	0.	0.	0.
GEORGIA	IV	3104.	3104.	0.	0.	0.	0.	0.	0.	0.	0.
HAWAII	IX	69.	69.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	13793.	13793.	0.	0.	0.	0.	0.	0.	0.	0.
INDIANA	V	5126.	5126.	0.	0.	0.	0.	0.	0.	0.	0.
IOWA	VII	2044.	2044.	0.	0.	0.	0.	0.	0.	0.	0.
KANSAS	VII	1507.	1507.	0.	0.	0.	0.	0.	0.	0.	0.
KENTUCKY	IV	1184.	1184.	0.	0.	0.	0.	0.	0.	0.	0.
LOUISIANA	VI	808.	808.	0.	0.	0.	0.	0.	0.	0.	0.
MAINE	I	608.	608.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	2824.	2824.	0.	0.	0.	0.	0.	0.	0.	0.
MASSACHUSETTS	I	15071.	15071.	0.	0.	0.	0.	0.	0.	0.	0.
MICHIGAN	V	5624.	5624.	0.	0.	0.	0.	0.	0.	0.	0.
MINNESOTA	V	1505.	1505.	0.	0.	0.	0.	0.	0.	0.	0.
MISSISSIPPI	IV	814.	814.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	1131.	1131.	0.	0.	0.	0.	0.	0.	0.	0.
MONTANA	VIII	68.	68.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	182.	182.	0.	0.	0.	0.	0.	0.	0.	0.
NEVADA	IX	69.	69.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	1313.	1313.	0.	0.	0.	0.	0.	0.	0.	0.
NEW JERSEY	II	10318.	10318.	0.	0.	0.	0.	0.	0.	0.	0.
NEW MEXICO	VI	69.	69.	0.	0.	0.	0.	0.	0.	0.	0.
NEW YORK	II	9947.	9947.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH CAROLINA	IV	9848.	9848.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH DAKOTA	VIII	120.	120.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	17269.	17269.	0.	0.	0.	0.	0.	0.	0.	0.
OKLAHOMA	VI	1525.	1525.	0.	0.	0.	0.	0.	0.	0.	0.
OREGON	X	1905.	1905.	0.	0.	0.	0.	0.	0.	0.	0.
PENNSYLVANIA	III	13888.	13888.	0.	0.	0.	0.	0.	0.	0.	0.
RHODE ISLAND	I	3550.	3550.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	7213.	7213.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH DAKOTA	VIII	120.	120.	0.	0.	0.	0.	0.	0.	0.	0.
TENNESSEE	IV	2271.	2271.	0.	0.	0.	0.	0.	0.	0.	0.
TEXAS	VI	3228.	3228.	0.	0.	0.	0.	0.	0.	0.	0.
UTAH	VIII	69.	69.	0.	0.	0.	0.	0.	0.	0.	0.
VERMONT	I	767.	767.	0.	0.	0.	0.	0.	0.	0.	0.
VIRGINIA	III	1450.	1450.	0.	0.	0.	0.	0.	0.	0.	0.
WASHINGTON	X	3059.	3059.	0.	0.	0.	0.	0.	0.	0.	0.
WEST VIRGINIA	III	386.	386.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	7463.	7463.	0.	0.	0.	0.	0.	0.	0.	0.
WYOMING	VIII	211.	211.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS		173000.	173000.	0.	0.	0.	0.	0.	0.	0.	0.
REGION I		26228.	26228.	0.	0.	0.	0.	0.	0.	0.	0.
II		20265.	20265.	0.	0.	0.	0.	0.	0.	0.	0.
III		19313.	19313.	0.	0.	0.	0.	0.	0.	0.	0.
IV		28734.	28734.	0.	0.	0.	0.	0.	0.	0.	0.
V		50773.	50773.	0.	0.	0.	0.	0.	0.	0.	0.
VI		6092.	6092.	0.	0.	0.	0.	0.	0.	0.	0.
VII		4871.	4871.	0.	0.	0.	0.	0.	0.	0.	0.
VIII		801.	801.	0.	0.	0.	0.	0.	0.	0.	0.
IX		10959.	10959.	0.	0.	0.	0.	0.	0.	0.	0.
X		4964.	4964.	0.	0.	0.	0.	0.	0.	0.	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — MACHINE SHOP
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	661.	422.	661.	422.	156.	25.2	10.2	0.	0.	225.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	186.	119.	186.	119.	44.	7.1	2.9	0.	0.	64.
ARKANSAS	VI	176.	112.	176.	112.	42.	6.7	2.7	0.	0.	60.
CALIFORNIA	IX	4202.	2683.	4202.	2683.	991.	159.9	64.8	0.	0.	1433.
COLORADO	VIII	89.	57.	89.	57.	21.	3.4	1.4	0.	0.	30.
CONNECTICUT	I	1990.	1271.	1990.	1271.	469.	75.7	30.7	0.	0.	679.
DELAWARE	III	309.	198.	309.	198.	73.	11.8	4.8	0.	0.	105.
FLORIDA	IV	1079.	689.	1079.	689.	254.	41.0	16.6	0.	0.	368.
GEORGIA	IV	1256.	802.	1256.	802.	296.	47.8	19.4	0.	0.	428.
HAWAII	IX	28.	18.	28.	18.	7.	1.1	.4	0.	0.	10.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	5581.	3564.	5581.	3564.	1316.	212.4	86.1	0.	0.	1903.
INDIANA	V	2074.	1325.	2074.	1325.	489.	78.9	32.0	0.	0.	707.
IOWA	VII	827.	528.	827.	528.	195.	31.5	12.8	0.	0.	282.
KANSAS	VII	610.	389.	610.	389.	144.	23.2	9.4	0.	0.	208.
KENTUCKY	IV	479.	306.	479.	306.	113.	18.2	7.4	0.	0.	163.
LOUISIANA	VI	327.	209.	327.	209.	77.	12.4	5.0	0.	0.	112.
MAINE	I	246.	157.	246.	157.	58.	9.4	3.8	0.	0.	84.
MARYLAND	III	1143.	730.	1143.	730.	269.	43.5	17.6	0.	0.	390.
MASSACHUSETTS	I	6098.	3894.	6098.	3894.	1437.	232.1	94.1	0.	0.	2079.
MICHIGAN	V	2276.	1453.	2276.	1453.	536.	86.6	35.1	0.	0.	776.
MINNESOTA	V	609.	389.	609.	389.	144.	23.2	9.4	0.	0.	208.
MISSISSIPPI	IV	329.	210.	329.	210.	78.	12.5	5.1	0.	0.	112.
MISSOURI	VII	458.	292.	458.	292.	108.	17.4	7.1	0.	0.	156.
MONTANA	VIII	27.	18.	27.	18.	6.	1.0	.4	0.	0.	9.
NEBRASKA	VII	74.	47.	74.	47.	17.	2.8	1.1	0.	0.	25.
NEVADA	IX	28.	18.	28.	18.	7.	1.1	.4	0.	0.	10.
NEW HAMPSHIRE	I	531.	339.	531.	339.	125.	20.2	8.2	0.	0.	181.
NEW JERSEY	II	4175.	2666.	4175.	2666.	984.	158.9	64.4	0.	0.	1423.
NEW MEXICO	VI	28.	18.	28.	18.	7.	1.1	.4	0.	0.	10.
NEW YORK	II	4025.	2570.	4025.	2570.	949.	153.2	62.1	0.	0.	1372.
NORTH CAROLINA	IV	3985.	2545.	3985.	2545.	939.	151.7	61.5	0.	0.	1359.
NORTH DAKOTA	VIII	49.	31.	49.	31.	11.	1.8	.7	0.	0.	17.
OHIO	V	6987.	4462.	6987.	4462.	1647.	265.9	107.8	0.	0.	2382.
OKLAHOMA	VI	617.	394.	617.	394.	145.	23.5	9.5	0.	0.	210.
OREGON	X	771.	492.	771.	492.	182.	29.3	11.9	0.	0.	263.
PENNSYLVANIA	III	5619.	3588.	5619.	3588.	1325.	213.9	86.7	0.	0.	1916.
RHODE ISLAND	I	1437.	917.	1437.	917.	339.	54.7	22.2	0.	0.	490.
SOUTH CAROLINA	IV	2918.	1864.	2918.	1864.	688.	111.1	45.0	0.	0.	995.
SOUTH DAKOTA	VIII	49.	31.	49.	31.	11.	1.8	.7	0.	0.	17.
TENNESSEE	IV	919.	587.	919.	587.	217.	35.0	14.2	0.	0.	313.
TEXAS	VI	1306.	834.	1306.	834.	308.	49.7	20.2	0.	0.	445.
UTAH	VIII	28.	18.	28.	18.	7.	1.1	.4	0.	0.	10.
VERMONT	I	311.	198.	311.	198.	73.	11.8	4.8	0.	0.	106.
VIRGINIA	III	587.	375.	587.	375.	138.	22.3	9.1	0.	0.	200.
WASHINGTON	X	1238.	790.	1238.	790.	292.	47.1	19.1	0.	0.	422.
WEST VIRGINIA	III	156.	100.	156.	100.	37.	5.9	2.4	0.	0.	53.
WISCONSIN	V	3020.	1928.	3020.	1928.	712.	114.9	46.6	0.	0.	1029.
WYOMING	VIII	85.	54.	85.	54.	20.	3.2	1.3	0.	0.	29.
TOTALS		70000.	44700.	70000.	44700.	16500.	2664.0	1080.0	0.	0.	23865.
REGION I		10613.	6777.	10613.	6777.	2502.	403.9	163.7	0.	0.	3618.
II		8200.	5236.	8200.	5236.	1933.	312.1	126.5	0.	0.	2796.
III		7814.	4990.	7814.	4990.	1842.	297.4	120.6	0.	0.	2664.
IV		11627.	7424.	11627.	7424.	2741.	442.5	179.4	0.	0.	3964.
V		20544.	13119.	20544.	13119.	4843.	781.8	317.0	0.	0.	7004.
VI		2465.	1574.	2465.	1574.	581.	93.8	38.0	0.	0.	840.
VII		1971.	1258.	1971.	1258.	465.	75.0	30.4	0.	0.	672.
VIII		324.	207.	324.	207.	76.	12.3	5.0	0.	0.	111.
IX		4434.	2832.	4434.	2832.	1045.	168.8	68.4	0.	0.	1512.
X		2008.	1283.	2008.	1283.	473.	76.4	31.0	0.	0.	685.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — HEAT TREATING
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	78.	34.	78.	34.	0.	0.	29.7	2.0	.8	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	22.	10.	22.	10.	0.	0.	8.4	.6	.2	0.
ARKANSAS	VI	21.	9.	21.	9.	0.	0.	7.9	.5	.2	0.
CALIFORNIA	IX	498.	219.	498.	219.	0.	0.	188.6	12.4	5.3	0.
COLORADO	VIII	11.	5.	11.	5.	0.	0.	4.0	.3	.1	0.
CONNECTICUT	I	236.	104.	236.	104.	0.	0.	89.3	5.9	2.5	0.
DELAWARE	III	37.	16.	37.	16.	0.	0.	13.9	.9	.4	0.
FLORIDA	IV	128.	56.	128.	56.	0.	0.	48.4	3.2	1.4	0.
GEORGIA	IV	149.	65.	149.	65.	0.	0.	56.4	3.7	1.6	0.
HAWAII	IX	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	662.	291.	662.	291.	0.	0.	250.5	16.5	7.0	0.
INDIANA	V	246.	108.	246.	108.	0.	0.	93.1	6.1	2.6	0.
IOWA	VII	98.	43.	98.	43.	0.	0.	37.1	2.4	1.0	0.
KANSAS	VII	72.	32.	72.	32.	0.	0.	27.4	1.8	.8	0.
KENTUCKY	IV	57.	25.	57.	25.	0.	0.	21.5	1.4	.6	0.
LOUISIANA	VI	39.	17.	39.	17.	0.	0.	14.7	1.0	.4	0.
MAINE	I	29.	13.	29.	13.	0.	0.	11.0	.7	.3	0.
MARYLAND	III	135.	60.	135.	60.	0.	0.	51.3	3.4	1.4	0.
MASSACHUSETTS	I	723.	318.	723.	318.	0.	0.	273.7	18.0	7.7	0.
MICHIGAN	V	270.	119.	270.	119.	0.	0.	102.1	6.7	2.9	0.
MINNESOTA	V	72.	32.	72.	32.	0.	0.	27.3	1.8	.8	0.
MISSISSIPPI	IV	39.	17.	39.	17.	0.	0.	14.8	1.0	.4	0.
MISSOURI	VII	54.	24.	54.	24.	0.	0.	20.5	1.4	.6	0.
MONTANA	VIII	3.	1.	3.	1.	0.	0.	1.2	.1	.0	0.
NEBRASKA	VII	9.	4.	9.	4.	0.	0.	3.3	.2	.1	0.
NEVADA	IX	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
NEW HAMPSHIRE	I	63.	28.	63.	28.	0.	0.	23.8	1.6	.7	0.
NEW JERSEY	II	495.	218.	495.	218.	0.	0.	187.4	12.3	5.2	0.
NEW MEXICO	VI	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
NEW YORK	II	477.	210.	477.	210.	0.	0.	180.7	11.9	5.1	0.
NORTH CAROLINA	IV	472.	208.	472.	208.	0.	0.	178.9	11.8	5.0	0.
NORTH DAKOTA	VIII	6.	3.	6.	3.	0.	0.	2.2	.1	.1	0.
OHIO	V	829.	364.	829.	364.	0.	0.	313.6	20.7	8.8	0.
OKLAHOMA	VI	73.	32.	73.	32.	0.	0.	27.7	1.8	.8	0.
OREGON	X	91.	40.	91.	40.	0.	0.	34.6	2.3	1.0	0.
PENNSYLVANIA	III	666.	293.	666.	293.	0.	0.	252.2	16.6	7.1	0.
RHODE ISLAND	I	170.	75.	170.	75.	0.	0.	64.5	4.2	1.8	0.
SOUTH CAROLINA	IV	346.	152.	346.	152.	0.	0.	131.0	8.6	3.7	0.
SOUTH DAKOTA	VIII	6.	3.	6.	3.	0.	0.	2.2	.1	.1	0.
TENNESSEE	IV	109.	48.	109.	48.	0.	0.	41.3	2.7	1.2	0.
TEXAS	VI	155.	68.	155.	68.	0.	0.	58.6	3.9	1.6	0.
UTAH	VIII	3.	1.	3.	1.	0.	0.	1.3	.1	.0	0.
VERMONT	I	37.	16.	37.	16.	0.	0.	13.9	.9	.4	0.
VIRGINIA	III	70.	31.	70.	31.	0.	0.	26.3	1.7	.7	0.
WASHINGTON	X	147.	65.	147.	65.	0.	0.	55.5	3.7	1.6	0.
WEST VIRGINIA	III	19.	8.	19.	8.	0.	0.	7.0	.5	.2	0.
WISCONSIN	V	358.	157.	358.	157.	0.	0.	135.5	8.9	3.8	0.
WYOMING	VIII	10.	4.	10.	4.	0.	0.	3.8	.3	.1	0.
TOTALS		8300.	3650.	8300.	3650.	0.	0.	3142.0	207.0	88.0	0.
REGION I		1258.	553.	1258.	553.	0.	0.	476.4	31.4	13.3	0.
II		972.	428.	972.	428.	0.	0.	368.1	24.2	10.3	0.
III		927.	407.	927.	407.	0.	0.	350.8	23.1	9.8	0.
IV		1379.	606.	1379.	606.	0.	0.	521.9	34.4	14.6	0.
V		2436.	1071.	2436.	1071.	0.	0.	922.1	60.8	25.8	0.
VI		292.	129.	292.	129.	0.	0.	110.6	7.3	3.1	0.
VII		234.	103.	234.	103.	0.	0.	88.5	5.8	2.5	0.
VIII		38.	17.	38.	17.	0.	0.	14.6	1.0	.4	0.
IX		526.	231.	526.	231.	0.	0.	199.0	13.1	5.6	0.
X		238.	105.	238.	105.	0.	0.	90.2	5.9	2.5	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — ELECTROPLATING
1977 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	**EPA Region**	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	35.	14.	35.	14.	6.	.3	.3	.7	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	10.	4.	10.	4.	2.	.1	.1	.2	0.	0.
ARKANSAS	VI	9.	4.	9.	4.	2.	.1	.1	.2	0.	0.
CALIFORNIA	IX	222.	90.	222.	90.	41.	1.7	1.7	4.3	0.	0.
COLORADO	VIII	5.	2.	5.	2.	1.	.0	.0	.1	0.	0.
CONNECTICUT	I	105.	43.	105.	43.	19.	.8	.8	2.0	0.	0.
DELAWARE	III	16.	7.	16.	7.	3.	.1	.1	.3	0.	0.
FLORIDA	IV	57.	23.	57.	23.	10.	.4	.4	1.1	0.	0.
GEORGIA	IV	66.	27.	66.	27.	12.	.5	.5	1.3	0.	0.
HAWAII	IX	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	295.	120.	295.	120.	54.	2.3	2.2	5.7	0.	0.
INDIANA	V	110.	44.	110.	44.	20.	.9	.8	2.1	0.	0.
IOWA	VII	44.	18.	44.	18.	8.	.3	.3	.9	0.	0.
KANSAS	VII	32.	13.	32.	13.	6.	.3	.2	.6	0.	0.
KENTUCKY	IV	25.	10.	25.	10.	5.	.2	.2	.5	0.	0.
LOUISIANA	VI	17.	7.	17.	7.	3.	.1	.1	.3	0.	0.
MAINE	I	13.	5.	13.	5.	2.	.1	.1	.3	0.	0.
MARYLAND	III	60.	24.	60.	24.	11.	.5	.5	1.2	0.	0.
MASSACHUSETTS	I	322.	131.	322.	131.	59.	2.5	2.4	6.3	0.	0.
MICHIGAN	V	120.	49.	120.	49.	22.	.9	.9	2.3	0.	0.
MINNESOTA	V	32.	13.	32.	13.	6.	.3	.2	.6	0.	0.
MISSISSIPPI	IV	17.	7.	17.	7.	3.	.1	.1	.3	0.	0.
MISSOURI	VII	24.	10.	24.	10.	4.	.2	.2	.5	0.	0.
MONTANA	VIII	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
NEBRASKA	VII	4.	2.	4.	2.	1.	.0	.0	.1	0.	0.
NEVADA	IX	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
NEW HAMPSHIRE	I	28.	11.	28.	11.	5.	.2	.2	.5	0.	0.
NEW JERSEY	II	221.	89.	221.	89.	41.	1.7	1.7	4.3	0.	0.
NEW MEXICO	VI	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
NEW YORK	II	213.	86.	213.	86.	39.	1.7	1.6	4.1	0.	0.
NORTH CAROLINA	IV	211.	85.	211.	85.	39.	1.7	1.6	4.1	0.	0.
NORTH DAKOTA	VIII	3.	1.	3.	1.	0.	.0	.0	.0	0.	0.
OHIO	V	369.	150.	369.	150.	68.	2.9	2.8	7.2	0.	0.
OKLAHOMA	VI	33.	13.	33.	13.	6.	.3	.2	.6	0.	0.
OREGON	X	41.	17.	41.	17.	7.	.3	.3	.8	0.	0.
PENNSYLVANIA	III	297.	120.	297.	120.	55.	2.3	2.2	5.8	0.	0.
RHODE ISLAND	I	76.	31.	76.	31.	14.	.6	.6	1.5	0.	0.
SOUTH CAROLINA	IV	154.	63.	154.	63.	28.	1.2	1.2	3.0	0.	0.
SOUTH DAKOTA	VIII	3.	1.	3.	1.	0.	.0	.0	.0	0.	0.
TENNESSEE	IV	49.	20.	49.	20.	9.	.4	.4	.9	0.	0.
TEXAS	VI	69.	28.	69.	28.	13.	.5	.5	1.3	0.	0.
UTAH	VIII	1.	1.	1.	1.	0.	.0	.0	.0	0.	0.
VERMONT	I	16.	7.	16.	7.	3.	.1	.1	.3	0.	0.
VIRGINIA	III	31.	13.	31.	13.	6.	.2	.2	.6	0.	0.
WASHINGTON	X	65.	27.	65.	27.	12.	.5	.5	1.3	0.	0.
WEST VIRGINIA	III	8.	3.	8.	3.	2.	.1	.1	.2	0.	0.
WISCONSIN	V	160.	65.	160.	65.	29.	1.3	1.2	3.1	0.	0.
WYOMING	VIII	5.	2.	5.	2.	1.	.0	.0	.1	0.	0.
TOTALS		3700.	1500.	3700.	1500.	680.	29.0	28.0	72.0	0.	0.
REGION I		561.	227.	561.	227.	103.	4.4	4.2	10.9	0.	0.
II		433.	176.	433.	176.	80.	3.4	3.3	8.4	0.	0.
III		413.	167.	413.	167.	76.	3.2	3.1	8.0	0.	0.
IV		615.	249.	615.	249.	113.	4.8	4.7	12.0	0.	0.
V		1086.	440.	1086.	440.	200.	8.5	8.2	21.1	0.	0.
VI		130.	53.	130.	53.	24.	1.0	1.0	2.5	0.	0.
VII		104.	42.	104.	42.	19.	.8	.8	2.0	0.	0.
VIII		17.	7.	17.	7.	3.	.1	.1	.3	0.	0.
IX		234.	95.	234.	95.	43.	1.8	1.8	4.6	0.	0.
X		106.	43.	106.	43.	20.	.8	.8	2.1	0.	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — COATING
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	85.	63.	85.	63.	46.	6.9	.1	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	24.	18.	24.	18.	13.	1.9	.0	0.	0.	0.
ARKANSAS	VI	23.	17.	23.	17.	12.	1.8	.0	0.	0.	0.
CALIFORNIA	IX	540.	402.	540.	402.	291.	43.8	.8	0.	0.	0.
COLORADO	VIII	11.	9.	11.	9.	6.	.9	.0	0.	0.	0.
CONNECTICUT	I	256.	190.	256.	190.	138.	20.7	.4	0.	0.	0.
DELAWARE	III	40.	30.	40.	30.	21.	3.2	.1	0.	0.	0.
FLORIDA	IV	139.	103.	139.	103.	75.	11.2	.2	0.	0.	0.
GEORGIA	IV	161.	120.	161.	120.	87.	13.1	.3	0.	0.	0.
HAWAII	IX	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	718.	534.	718.	534.	387.	58.1	1.1	0.	0.	0.
INDIANA	V	267.	199.	267.	199.	144.	21.6	.4	0.	0.	0.
IOWA	VII	106.	79.	106.	79.	57.	8.6	.2	0.	0.	0.
KANSAS	VII	78.	58.	78.	58.	42.	6.3	.1	0.	0.	0.
KENTUCKY	IV	62.	46.	62.	46.	33.	5.0	.1	0.	0.	0.
LOUISIANA	VI	42.	31.	42.	31.	23.	3.4	.1	0.	0.	0.
MAINE	I	32.	24.	32.	24.	17.	2.6	.0	0.	0.	0.
MARYLAND	III	147.	109.	147.	109.	79.	11.9	.2	0.	0.	0.
MASSACHUSETTS	I	784.	584.	784.	584.	423.	63.5	1.2	0.	0.	0.
MICHIGAN	V	293.	218.	293.	218.	158.	23.7	.5	0.	0.	0.
MINNESOTA	V	78.	58.	78.	58.	42.	6.3	.1	0.	0.	0.
MISSISSIPPI	IV	42.	32.	42.	32.	23.	3.4	.1	0.	0.	0.
MISSOURI	VII	59.	44.	59.	44.	32.	4.8	.1	0.	0.	0.
MONTANA	VIII	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
NEBRASKA	VII	9.	7.	9.	7.	5.	.8	.0	0.	0.	0.
NEVADA	IX	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
NEW HAMPSHIRE	I	68.	51.	68.	51.	37.	5.5	.1	0.	0.	0.
NEW JERSEY	II	537.	400.	537.	400.	289.	43.5	.8	0.	0.	0.
NEW MEXICO	VI	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
NEW YORK	II	517.	385.	517.	385.	279.	41.9	.8	0.	0.	0.
NORTH CAROLINA	IV	512.	381.	512.	381.	276.	41.5	.8	0.	0.	0.
NORTH DAKOTA	VIII	6.	5.	6.	5.	3.	.5	.0	0.	0.	0.
OHIO	V	898.	669.	898.	669.	484.	72.8	1.4	0.	0.	0.
OKLAHOMA	VI	79.	59.	79.	59.	43.	6.4	.1	0.	0.	0.
OREGON	X	99.	74.	99.	74.	53.	8.0	.2	0.	0.	0.
PENNSYLVANIA	III	722.	538.	722.	538.	390.	58.5	1.1	0.	0.	0.
RHODE ISLAND	I	185.	138.	185.	138.	100.	15.0	.3	0.	0.	0.
SOUTH CAROLINA	IV	375.	279.	375.	279.	202.	30.4	.6	0.	0.	0.
SOUTH DAKOTA	VIII	6.	5.	6.	5.	3.	.5	.0	0.	0.	0.
TENNESSEE	IV	118.	88.	118.	88.	64.	9.6	.2	0.	0.	0.
TEXAS	VI	168.	125.	168.	125.	91.	13.6	.3	0.	0.	0.
UTAH	VIII	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
VERMONT	I	40.	30.	40.	30.	22.	3.2	.1	0.	0.	0.
VIRGINIA	III	75.	56.	75.	56.	41.	6.1	.1	0.	0.	0.
WASHINGTON	X	159.	118.	159.	118.	86.	12.9	.2	0.	0.	0.
WEST VIRGINIA	III	20.	15.	20.	15.	11.	1.6	.0	0.	0.	0.
WISCONSIN	V	388.	289.	388.	289.	209.	31.4	.6	0.	0.	0.
WYOMING	VIII	11.	8.	11.	8.	6.	.9	.0	0.	0.	0.
TOTALS		9000.	6700.	9000.	6700.	4853.	729.0	14.0	0.	0.	0.
REGION I		1364.	1016.	1364.	1016.	736.	110.5	2.1	0.	0.	0.
II		1054.	785.	1054.	785.	568.	85.4	1.6	0.	0.	0.
III		1005.	748.	1005.	748.	542.	81.4	1.6	0.	0.	0.
IV		1495.	1113.	1495.	1113.	806.	121.1	2.3	0.	0.	0.
V		2641.	1966.	2641.	1966.	1424.	214.0	4.1	0.	0.	0.
VI		317.	236.	317.	236.	171.	25.7	.5	0.	0.	0.
VII		253.	189.	253.	189.	137.	20.5	.4	0.	0.	0.
VIII		42.	31.	42.	31.	22.	3.4	.1	0.	0.	0.
IX		570.	424.	570.	424.	307.	46.2	.9	0.	0.	0.
X		258.	192.	258.	192.	139.	20.9	.4	0.	0.	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — FERROUS AND NONFERROUS FOUNDRY
1977 State and EPA Region Totals
(kkg/year)

				Total Potentially		Total Hazardous Constituents (Dry Wt.)					
	EPA	Total Waste		Hazardous Waste		Flammable	Heavy		Acids/Alkali		Sweepings &
State	**Region**	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	**Solvents**	**Metals**	**Oils**	**Solution**	**Cyanide**	**Grindings**
ALABAMA	IV	1521.	1521.	0.	0.	0.	0.	0.	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	429.	429.	0.	0.	0.	0.	0.	0.	0.	0.
ARKANSAS	VI	405.	405.	0.	0.	0.	0.	0.	0.	0.	0.
CALIFORNIA	IX	9665.	9665.	0.	0.	0.	0.	0.	0.	0.	0.
COLORADO	VIII	205.	205.	0.	0.	0.	0.	0.	0.	0.	0.
CONNECTICUT	I	4577.	4577.	0.	0.	0.	0.	0.	0.	0.	0.
DELAWARE	III	712.	712.	0.	0.	0.	0.	0.	0.	0.	0.
FLORIDA	IV	2481.	2481.	0.	0.	0.	0.	0.	0.	0.	0.
GEORGIA	IV	2889.	2889.	0.	0.	0.	0.	0.	0.	0.	0.
HAWAII	IX	64.	64.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	12836.	12836.	0.	0.	0.	0.	0.	0.	0.	0.
INDIANA	V	4771.	4771.	0.	0.	0.	0.	0.	0.	0.	0.
IOWA	VII	1902.	1902.	0.	0.	0.	0.	0.	0.	0.	0.
KANSAS	VII	1402.	1402.	0.	0.	0.	0.	0.	0.	0.	0.
KENTUCKY	IV	1102.	1102.	0.	0.	0.	0.	0.	0.	0.	0.
LOUISIANA	VI	752.	752.	0.	0.	0.	0.	0.	0.	0.	0.
MAINE	I	566.	566.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	2628.	2628.	0.	0.	0.	0.	0.	0.	0.	0.
MASSACHUSETTS	I	14026.	14026.	0.	0.	0.	0.	0.	0.	0.	0.
MICHIGAN	V	5234.	5234.	0.	0.	0.	0.	0.	0.	0.	0.
MINNESOTA	V	1401.	1401.	0.	0.	0.	0.	0.	0.	0.	0.
MISSISSIPPI	IV	758.	758.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	1052.	1052.	0.	0.	0.	0.	0.	0.	0.	0.
MONTANA	VIII	63.	63.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	170.	170.	0.	0.	0.	0.	0.	0.	0.	0.
NEVADA	IX	64.	64.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	1222.	1222.	0.	0.	0.	0.	0.	0.	0.	0.
NEW JERSEY	II	9602.	9602.	0.	0.	0.	0.	0.	0.	0.	0.
NEW MEXICO	VI	64.	64.	0.	0.	0.	0.	0.	0.	0.	0.
NEW YORK	II	9257.	9257.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH CAROLINA	IV	9165.	9165.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH DAKOTA	VIII	112.	112.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	16071.	16071.	0.	0.	0.	0.	0.	0.	0.	0.
OKLAHOMA	VI	1419.	1419.	0.	0.	0.	0.	0.	0.	0.	0.
OREGON	X	1773.	1773.	0.	0.	0.	0.	0.	0.	0.	0.
PENNSYLVANIA	III	12925.	12925.	0.	0.	0.	0.	0.	0.	0.	0.
RHODE ISLAND	I	3304.	3304.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	6712.	6712.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH DAKOTA	VIII	112.	112.	0.	0.	0.	0.	0.	0.	0.	0.
TENNESSEE	IV	2114.	2114.	0.	0.	0.	0.	0.	0.	0.	0.
TEXAS	VI	3004.	3004.	0.	0.	0.	0.	0.	0.	0.	0.
UTAH	VIII	64.	64.	0.	0.	0.	0.	0.	0.	0.	0.
VERMONT	I	714.	714.	0.	0.	0.	0.	0.	0.	0.	0.
VIRGINIA	III	1350.	1350.	0.	0.	0.	0.	0.	0.	0.	0.
WASHINGTON	X	2846.	2846.	0.	0.	0.	0.	0.	0.	0.	0.
WEST VIRGINIA	III	359.	359.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	6945.	6945.	0.	0.	0.	0.	0.	0.	0.	0.
WYOMING	VIII	196.	196.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS		161000.	161000.	0.	0.	0.	0.	0.	0.	0.	0.
REGION I		24409.	24409.	0.	0.	0.	0.	0.	0.	0.	0.
II		18859.	18859.	0.	0.	0.	0.	0.	0.	0.	0.
III		17973.	17973.	0.	0.	0.	0.	0.	0.	0.	0.
IV		26741.	26741.	0.	0.	0.	0.	0.	0.	0.	0.
V		47251.	47251.	0.	0.	0.	0.	0.	0.	0.	0.
VI		5669.	5669.	0.	0.	0.	0.	0.	0.	0.	0.
VII		4533.	4533.	0.	0.	0.	0.	0.	0.	0.	0.
VIII		746.	746.	0.	0.	0.	0.	0.	0.	0.	0.
IX		10199.	10199.	0.	0.	0.	0.	0.	0.	0.	0.
X		4620.	4620.	0.	0.	0.	0.	0.	0.	0.	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION -- MACHINE SHOP
1983 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	793.	604.	727.	538.	131.	21.8	37.5	0.	.0	191.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	224.	170.	205.	152.	37.	6.1	10.6	0.	.0	54.
ARKANSAS	VI	211.	161.	194.	143.	35.	5.8	10.0	0.	.0	51.
CALIFORNIA	IX	5043.	3842.	4622.	3422.	832.	138.4	238.3	0.	.1	1212.
COLORADO	VIII	107.	82.	98.	73.	18.	2.9	5.1	0.	.0	26.
CONNECTICUT	I	2386.	1820.	2189.	1621.	394.	65.5	112.9	0.	.1	574.
DELAWARE	III	371.	283.	340.	252.	61.	10.2	17.5	0.	.0	89.
FLORIDA	IV	1294.	986.	1186.	878.	214.	35.5	61.2	0.	.0	311.
GEORGIA	IV	1507.	1148.	1381.	1023.	249.	41.4	71.2	0.	.0	362.
HAWAII	IX	34.	26.	31.	23.	6.	.9	1.6	0.	.0	8.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	6697.	5103.	6139.	4545.	1105.	183.8	316.5	0.	.2	1610.
INDIANA	V	2489.	1896.	2282.	1689.	411.	68.3	117.6	0.	.1	598.
IOWA	VII	992.	756.	910.	673.	164.	27.2	46.9	0.	.0	239.
KANSAS	VII	732.	557.	671.	496.	121.	20.1	34.6	0.	.0	176.
KENTUCKY	IV	575.	438.	527.	390.	95.	15.8	27.2	0.	.0	138.
LOUISIANA	VI	393.	299.	360.	266.	65.	10.8	18.6	0.	.0	94.
MAINE	I	295.	225.	271.	200.	49.	8.1	13.9	0.	.0	71.
MARYLAND	III	1371.	1045.	1257.	930.	226.	37.6	64.8	0.	.0	330.
MASSACHUSETTS	I	7318.	5575.	6708.	4966.	1208.	200.8	345.8	0.	.2	1759.
MICHIGAN	V	2731.	2081.	2503.	1853.	451.	74.9	129.1	0.	.1	656.
MINNESOTA	V	731.	557.	670.	496.	121.	20.1	34.5	0.	.0	176.
MISSISSIPPI	IV	395.	301.	362.	268.	65.	10.8	18.7	0.	.0	95.
MISSOURI	VII	549.	418.	503.	373.	91.	15.1	25.9	0.	.0	132.
MONTANA	VIII	33.	25.	30.	22.	5.	.9	1.6	0.	.0	8.
NEBRASKA	VII	89.	67.	81.	60.	15.	2.4	4.2	0.	.0	21.
NEVADA	IX	34.	26.	31.	23.	6.	.9	1.6	0.	.0	8.
NEW HAMPSHIRE	I	638.	486.	584.	433.	105.	17.5	30.1	0.	.0	153.
NEW JERSEY	II	5010.	3817.	4592.	3399.	827.	137.5	236.8	0.	.1	1204.
NEW MEXICO	VI	34.	26.	31.	23.	6.	.9	1.6	0.	.0	8.
NEW YORK	II	4830.	3680.	4427.	3277.	797.	132.5	228.3	0.	.1	1161.
NORTH CAROLINA	IV	4782.	3643.	4383.	3245.	789.	131.2	226.0	0.	.1	1150.
NORTH DAKOTA	VIII	58.	44.	53.	40.	10.	1.6	2.8	0.	.0	14.
OHIO	V	8385.	6388.	7686.	5690.	1384.	230.1	396.3	0.	.2	2016.
OKLAHOMA	VI	740.	564.	679.	502.	122.	20.3	35.0	0.	.0	178.
OREGON	X	925.	705.	848.	628.	153.	25.4	43.7	0.	.0	222.
PENNSYLVANIA	III	6743.	5138.	6181.	4576.	1113.	185.0	318.7	0.	.2	1621.
RHODE ISLAND	I	1724.	1313.	1580.	1170.	285.	47.3	81.5	0.	.0	414.
SOUTH CAROLINA	IV	3502.	2668.	3210.	2376.	578.	96.1	165.5	0.	.1	842.
SOUTH DAKOTA	VIII	58.	44.	53.	40.	10.	1.6	2.8	0.	.0	14.
TENNESSEE	IV	1103.	840.	1011.	748.	182.	30.3	52.1	0.	.0	265.
TEXAS	VI	1567.	1194.	1437.	1064.	259.	43.0	74.1	0.	.0	377.
UTAH	VIII	34.	26.	31.	23.	6.	.9	1.6	0.	.0	8.
VERMONT	I	373.	284.	342.	253.	62.	10.2	17.6	0.	.0	90.
VIRGINIA	III	704.	536.	645.	478.	116.	19.3	33.3	0.	.0	169.
WASHINGTON	X	1485.	1131.	1361.	1008.	245.	40.8	70.2	0.	.0	357.
WEST VIRGINIA	III	187.	143.	172.	127.	31.	5.1	8.9	0.	.0	45.
WISCONSIN	V	3623.	2761.	3322.	2459.	598.	99.4	171.3	0.	.1	871.
WYOMING	VIII	102.	78.	94.	69.	17.	2.8	4.8	0.	.0	25.
TOTALS		84000.	64000.	77000.	57000.	13864.	2305.0	3970.0	0.	2.0	20194.
REGION I		12735.	9703.	11674.	8642.	2102.	349.5	601.9	0.	.3	3062.
II		9840.	7497.	9020.	6677.	1624.	270.0	465.0	0.	.2	2366.
III		9377.	7145.	8596.	6363.	1548.	257.3	443.2	0.	.2	2254.
IV		13952.	10630.	12789.	9467.	2303.	382.8	659.4	0.	.3	3354.
V		24653.	18783.	22598.	16729.	4069.	676.5	1165.1	0.	.6	5927.
VI		2958.	2254.	2711.	2007.	488.	81.2	139.8	0.	.1	711.
VII		2365	1802.	2168.	1605.	390.	64.9	111.8	0.	.1	569.
VIII		389.	296.	357.	264.	64.	10.7	18.4	0.	.0	94.
IX		5321.	4054.	4878.	3611.	878.	146.0	251.5	0.	.1	1279.
X		2410.	1836.	2209.	1635.	398.	66.1	113.9	0.	.1	579.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — HEAT TREATING
1983 State and EPA Region Totals
(kkg/year)

				Total Potentially		Total Hazardous Constituents (Dry Wt.)					
	EPA	Total Waste		Hazardous Waste		Flammable	Heavy		Acids/Alkali		Sweepings &
State	Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Solvents	Metals	Oils	Solution	Cyanide	Grindings
ALABAMA	IV	123.	90.	90.	57.	0.	0.	48.3	1.6	3.3	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	35.	25.	25.	16.	0.	0.	13.6	.4	.9	0.
ARKANSAS	VI	33.	24.	24.	15.	0.	0.	12.9	.4	.9	0.
CALIFORNIA	IX	780.	570.	570.	360.	0.	0.	307.0	9.9	21.0	0.
COLORADO	VIII	17.	12.	12.	8.	0.	0.	6.5	.2	.4	0.
CONNECTICUT	I	370.	270.	270.	171.	0.	0.	[illegible]	4.7	9.9	0.
DELAWARE	III	57.	42.	42.	27.	0.	0.	[illegible]	.7	1.5	0.
FLORIDA	IV	200.	146.	146.	92.	0.	0.	78.8	2.5	5.4	0.
GEORGIA	IV	233.	170.	170.	108.	0.	0.	91.8	3.0	6.3	0.
HAWAII	IX	5.	4.	4.	2.	0.	0.	2.0	.1	.1	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	1036.	757.	757.	478.	0.	0.	407.7	13.2	27.8	0.
INDIANA	V	385.	282.	282.	178.	0.	0.	151.5	4.9	10.3	0.
IOWA	VII	154.	112.	112.	71.	0.	0.	60.4	1.9	4.1	0.
KANSAS	VII	113.	83.	83.	52.	0.	0.	44.5	1.4	3.0	0.
KENTUCKY	IV	89.	65.	65.	41.	0.	0.	35.0	1.1	2.4	0.
LOUISIANA	VI	61.	44.	44.	28.	0.	0.	23.9	.8	1.6	0.
MAINE	I	46.	33.	33.	21.	0.	0.	18.0	.6	1.2	0.
MARYLAND	III	212.	155.	155.	98.	0.	0.	83.5	2.7	5.7	0.
MASSACHUSETTS	I	1132.	828.	828.	523.	0.	0.	445.5	14.4	30.4	0.
MICHIGAN	V	423.	309.	309.	195.	0.	0.	166.2	5.4	11.3	0.
MINNESOTA	V	113.	83.	83.	52.	0.	0.	44.5	1.4	3.0	0.
MISSISSIPPI	IV	61.	45.	45.	28.	0.	0.	24.1	.8	1.6	0.
MISSOURI	VII	85.	62.	62.	39.	0.	0.	33.4	1.1	2.3	0.
MONTANA	VIII	5.	4.	4.	2.	0.	0.	2.0	.1	.1	0.
NEBRASKA	VII	14.	10.	10.	6.	0.	0.	5.4	.2	.4	0.
NEVADA	IX	5.	4.	4.	2.	0.	0.	2.0	.1	.1	0.
NEW HAMPSHIRE	I	99.	72.	72.	46.	0.	0.	38.8	1.3	2.6	0.
NEW JERSEY	II	775.	567.	567.	358.	0.	0.	305.0	9.8	20.8	0.
NEW MEXICO	VI	5.	4.	4.	2.	0.	0.	2.0	.1	.1	0.
NEW YORK	II	747.	546.	546.	345.	0.	0.	294.1	9.5	20.1	0.
NORTH CAROLINA	IV	740.	541.	541.	342.	0.	0.	291.1	9.4	19.9	0.
NORTH DAKOTA	VIII	9.	7.	7.	4.	0.	0.	3.6	.1	.2	0.
OHIO	V	1298.	948.	948.	599.	0.	0.	510.5	16.5	34.3	0.
OKLAHOMA	VI	115.	84.	84.	53.	0.	0.	45.1	1.5	3.1	0.
OREGON	X	143.	105.	105.	66.	0.	0.	56.3	1.8	3.8	0.
PENNSYLVANIA	III	1044.	763.	763.	482.	0.	0.	410.5	13.2	28.0	0.
RHODE ISLAND	I	267.	195.	195.	123.	0.	0.	105.0	3.4	7.2	0.
SOUTH CAROLINA	IV	542.	396.	396.	250.	0.	0.	213.2	6.9	14.6	0.
SOUTH DAKOTA	VIII	9.	7.	7.	4.	0.	0.	3.6	.1	.2	0.
TENNESSEE	IV	171.	125.	125.	79.	0.	0.	67.1	2.2	4.6	0.
TEXAS	VI	243.	177.	177.	112.	0.	0.	95.4	3.1	6.5	0.
UTAH	VIII	5.	4.	4.	2.	0.	0.	2.0	.1	.1	0.
VERMONT	I	58.	42.	42.	27.	0.	0.	22.7	.7	1.5	0.
VIRGINIA	III	109.	80.	80.	50.	0.	0.	42.9	1.4	2.9	0.
WASHINGTON	X	230.	168.	168.	106.	0.	0.	90.4	2.9	6.2	0.
WEST VIRGINIA	III	29.	21.	21.	13.	0.	0.	11.4	.4	.8	0.
WISCONSIN	V	561.	410.	410.	259.	0.	0.	220.6	7.1	15.1	0.
WYOMING	VIII	16.	12.	12.	7.	0.	0.	6.2	.2	.4	0.
TOTALS		13000.	9500.	9500.	6000.	0.	0.	5114.0	165.0	349.0	0.
REGION I		1971.	1440.	1440.	910.	0.	0.	775.3	25.0	52.9	0.
II		1523.	1113.	1113.	703.	0.	0.	599.1	19.3	40.9	0.
III		1451.	1061.	1061.	670.	0.	0.	570.9	18.4	39.0	0.
IV		2159.	1578.	1578.	997.	0.	0.	849.4	27.4	58.0	0.
V		3815.	2788.	2788.	1761.	0.	0.	1500.9	48.4	102.4	0.
VI		458.	335.	335.	211.	0.	0.	180.1	5.8	12.3	0.
VII		366.	267.	267.	169.	0.	0.	144.0	4.6	9.8	0.
VIII		60.	44.	44.	28.	0.	0.	23.7	.8	1.6	0.
IX		824.	602.	602.	380.	0.	0.	324.0	10.5	22.1	0.
X		373.	273.	273.	172.	0.	0.	146.7	4.7	10.0	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — ELECTROPLATING
1983 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	76.	47.	38.	19.	6.	.7	3.9	.7	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	21.	13.	11.	5.	2.	.2	1.1	.2	0.	0.
ARKANSAS	VI	20.	13.	10.	5.	2.	.2	1.1	.2	0.	0.
CALIFORNIA	IX	480.	300.	240.	120.	41.	4.7	25.1	4.3	0.	0.
COLORADO	VIII	10.	6.	5.	3.	1.	.1	.5	.1	0.	0.
CONNECTICUT	I	227.	142.	114.	57.	19.	2.2	11.9	2.0	0.	0.
DELAWARE	III	35.	22.	18.	9.	3.	.3	1.8	.3	0.	0.
FLORIDA	IV	123.	77.	62.	31.	10.	1.2	6.4	1.1	0.	0.
GEORGIA	IV	144.	90.	72.	36.	12.	1.4	7.5	1.3	0.	0.
HAWAII	IX	3.	2.	2.	1.	0.	.0	.2	.0	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	638.	399.	319.	159.	54.	6.3	33.3	5.7	0.	0.
INDIANA	V	237.	148.	119.	59.	20.	2.3	12.4	2.1	0.	0.
IOWA	VII	95.	59.	47.	24.	8.	.9	4.9	.9	0.	0.
KANSAS	VII	70.	44.	35.	17.	6.	.7	3.6	.6	0.	0.
KENTUCKY	IV	55.	34.	27.	14.	5.	.5	2.9	.5	0.	0.
LOUISIANA	VI	37.	23.	19.	9.	3.	.4	2.0	.3	0.	0.
MAINE	I	28.	18.	14.	7.	2.	.3	1.5	.3	0.	0.
MARYLAND	III	131.	82.	65.	33.	11.	1.3	6.8	1.2	0.	0.
MASSACHUSETTS	I	697.	436.	348.	174.	59.	6.9	36.4	6.3	0.	0.
MICHIGAN	V	260.	163.	130.	65.	22.	2.6	13.6	2.3	0.	0.
MINNESOTA	V	70.	44.	35.	17.	6.	.7	3.6	.6	0.	0.
MISSISSIPPI	IV	38.	24.	19.	9.	3.	.4	2.0	.3	0.	0.
MISSOURI	VII	52.	33.	26.	13.	4.	.5	2.7	.5	0.	0.
MONTANA	VIII	3.	2.	2.	1.	0.	.0	.2	.0	0.	0.
NEBRASKA	VII	8.	5.	4.	2.	1.	.1	.4	.1	0.	0.
NEVADA	IX	3.	2.	2.	1.	0.	.0	.2	.0	0.	0.
NEW HAMPSHIRE	I	61.	38.	30.	15.	5.	.6	3.2	.5	0.	0.
NEW JERSEY	II	477.	298.	239.	119.	41.	4.7	24.9	4.3	0.	0.
NEW MEXICO	VI	3.	2.	2.	1.	0.	.0	.2	.0	0.	0.
NEW YORK	II	460.	287.	230.	115.	39.	4.5	24.0	4.1	0.	0.
NORTH CAROLINA	IV	455.	285.	228.	114.	39.	4.5	23.8	4.1	0.	0.
NORTH DAKOTA	VIII	6.	3.	3.	1.	0.	.1	.3	.0	0.	0.
OHIO	V	799.	499.	399.	200.	68.	7.9	41.7	7.2	0.	0.
OKLAHOMA	VI	71.	44.	35.	18.	6.	.7	3.7	.6	0.	0.
OREGON	X	88.	55.	44.	22.	7.	.9	4.6	.8	0.	0.
PENNSYLVANIA	III	642.	401.	321.	161.	55.	6.3	33.6	5.8	0.	0.
RHODE ISLAND	I	164.	103.	82.	41.	14.	1.6	8.6	1.5	0.	0.
SOUTH CAROLINA	IV	334.	208.	167.	83.	28.	3.3	17.4	3.0	0.	0.
SOUTH DAKOTA	VIII	6.	3.	3.	1.	0.	.1	.3	.0	0.	0.
TENNESSEE	IV	105.	66.	53.	26.	9.	1.0	5.5	.9	0.	0.
TEXAS	VI	149.	93.	75.	37.	13.	1.5	7.8	1.3	0.	0.
UTAH	VIII	3.	2.	2.	1.	0.	.0	.2	.0	0.	0.
VERMONT	I	35.	22.	18.	9.	3.	.4	1.9	.3	0.	0.
VIRGINIA	III	67.	42.	34.	17.	6.	.7	3.5	.6	0.	0.
WASHINGTON	X	141.	88.	71.	35.	12.	1.4	7.4	1.3	0.	0.
WEST VIRGINIA	III	18.	11.	9.	4.	2.	.2	.9	.2	0.	0.
WISCONSIN	V	345.	216.	173.	86.	29.	3.4	18.0	3.1	0.	0.
WYOMING	VIII	10.	6.	5.	2.	1.	.1	.5	.1	0.	0.
TOTALS		8000.	5000.	4000.	2000.	680.	79.0	418.0	72.0	0.	0.
REGION I		1213.	758.	606.	303.	103.	12.0	63.4	10.9	0.	0.
II		937.	586.	469.	234.	80.	9.3	49.0	8.4	0.	0.
III		893.	558.	447.	223.	76.	8.8	46.7	8.0	0.	0.
IV		1329.	830.	664.	332.	113.	13.1	69.4	12.0	0.	0.
V		2348.	1467.	1174.	587.	200.	23.2	122.7	21.1	0.	0.
VI		282.	176.	141.	70.	24.	2.8	14.7	2.5	0.	0.
VII		225.	141.	113.	56.	19.	2.2	11.8	2.0	0.	0.
VIII		37.	23.	19.	9.	3.	.4	1.9	.3	0.	0.
IX		507.	317.	253.	127.	43.	5.0	26.5	4.6	0.	0.
X		230.	143.	115.	57.	20.	2.3	12.0	2.1	0.	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION — COATING
1983 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	123.	104.	85.	66.	37.	6.0	19.2	0.	.0	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	35.	29.	24.	19.	10.	1.7	5.4	0.	.0	0.
ARKANSAS	VI	33.	28.	23.	18.	10.	1.6	5.1	0.	.0	0.
CALIFORNIA	IX	780.	660.	540.	420.	233.	38.3	122.2	0.	.2	0.
COLORADO	VIII	17.	14.	11.	9.	5.	.8	2.6	0.	.0	0.
CONNECTICUT	I	370.	313.	256.	199.	110.	18.1	57.9	0.	.1	0.
DELAWARE	III	57.	49.	40.	31.	17.	2.8	9.0	0.	.0	0.
FLORIDA	IV	200.	169.	139.	108.	60.	9.8	31.4	0.	.1	0.
GEORGIA	IV	233.	197.	161.	126.	70.	11.4	36.5	0.	.1	0.
HAWAII	IX	5.	4.	4.	3.	2.	.3	.8	0.	.0	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	1036.	877.	718.	558.	310.	50.9	162.3	0.	.3	0.
INDIANA	V	385.	326.	267.	207.	115.	18.9	60.3	0.	.1	0.
IOWA	VII	154.	130.	106.	83.	46.	7.5	24.0	0.	.0	0.
KANSAS	VII	113.	96.	78.	61.	34.	5.6	17.7	0.	.0	0.
KENTUCKY	IV	89.	75.	62.	48.	27.	4.4	13.9	0.	.0	0.
LOUISIANA	VI	61.	51.	42.	33.	18.	3.0	9.5	0.	.0	0.
MAINE	I	46.	39.	32.	25.	14.	2.2	7.1	0.	.0	0.
MARYLAND	III	212.	180.	147.	114.	63.	10.4	33.2	0.	.1	0.
MASSACHUSETTS	I	1132.	958.	784.	610.	338.	55.6	177.3	0.	.3	0.
MICHIGAN	V	423.	358.	293.	228.	126.	20.7	66.2	0.	.1	0.
MINNESOTA	V	113.	96.	78.	61.	34.	5.6	17.7	0.	.0	0.
MISSISSIPPI	IV	61.	52.	42.	33.	18.	3.0	9.6	0.	[illegible]	0.
MISSOURI	VII	85.	72.	59.	46.	25.	4.2	13.3	0.	.0	0.
MONTANA	VIII	5.	4.	4.	3.	2.	.3	.8	0.	.0	0.
NEBRASKA	VII	14.	12.	9.	7.	4.	.7	2.1	0.	.0	0.
NEVADA	IX	5.	4.	4.	3.	2.	.3	.8	0.	.0	0.
NEW HAMPSHIRE	I	99.	83.	68.	53.	29.	4.8	15.4	0.	.0	0.
NEW JERSEY	II	775.	656.	537.	417.	232.	38.1	121.4	0.	.2	0.
NEW MEXICO	VI	5.	4.	4.	3.	2.	.3	.8	0.	.0	0.
NEW YORK	II	747.	632.	517.	402.	223.	36.7	117.0	0.	.2	0.
NORTH CAROLINA	IV	740.	626.	512.	398.	221.	36.3	115.8	0.	.2	0.
NORTH DAKOTA	VIII	9.	8.	6.	5.	3.	.4	1.4	0.	.0	0.
OHIO	V	1298.	1098.	898.	699.	387.	63.7	203.1	0.	.4	0.
OKLAHOMA	VI	115.	97.	79.	62.	34.	5.6	17.9	0.	.0	0.
OREGON	X	143.	121.	99.	77.	43.	7.0	22.4	0.	.0	0.
PENNSYLVANIA	III	1044.	883.	722.	562.	312.	51.2	163.4	0.	.3	0.
RHODE ISLAND	I	267.	226.	185.	144.	80.	13.1	41.8	0.	.1	0.
SOUTH CAROLINA	IV	542.	459.	375.	292.	162.	26.6	84.8	0.	.2	0.
SOUTH DAKOTA	VIII	9.	8.	6.	5.	3.	.4	1.4	0.	.0	0.
TENNESSEE	IV	171.	144.	118.	92.	51.	8.4	26.7	0.	.1	0.
TEXAS	VI	243.	205.	168.	131.	72.	11.9	38.0	0.	.1	0.
UTAH	VIII	5.	4.	4.	3.	2.	.3	.8	0.	.0	0.
VERMONT	I	58.	49.	40.	31.	17.	2.8	9.0	0.	.0	0.
VIRGINIA	III	109.	92.	75.	59.	33.	5.3	17.1	0.	.0	0.
WASHINGTON	X	230.	194.	159.	124.	69.	11.3	36.0	0.	.1	0.
WEST VIRGINIA	III	29.	25.	20.	16.	9.	1.4	4.5	0.	.0	0.
WISCONSIN	V	561.	475.	388.	302.	167.	27.5	87.8	0.	.2	0.
WYOMING	VIII	16.	13.	11.	9.	3.	.8	2.5	0.	.0	0.
TOTALS		13000.	11000.	9000.	7000.	3882.	638.0	2035.0	0.	4.0	0.
REGION I		1971.	1668.	1364.	1061.	589.	96.7	308.5	0.	.6	0.
II		1523.	1289.	1054.	820.	455.	74.7	238.4	0.	.5	0.
III		1451.	1228.	1005.	781.	433.	71.2	227.2	0.	.4	0.
IV		2159.	1827.	1495.	1163.	645.	106.0	338.0	0.	.7	0.
V		3815.	3228.	2641.	2054.	1139.	187.2	597.2	0.	1.2	0.
VI		458.	387.	317.	246.	137.	22.5	71.7	0.	.1	0.
VII		366.	310.	253.	197.	109.	18.0	57.3	0.	.1	0.
VIII		60.	51.	42.	32.	18.	3.0	9.4	0.	.0	0.
IX		824.	697.	570.	443.	246.	40.4	128.9	0.	.3	0.
X		373.	316.	258.	201.	111.	18.3	58.4	0.	.1	0.

SPECIAL INDUSTRIAL MACHINERY MANUFACTURING
SIC 355
PROCESS WASTE GENERATION -- FERROUS AND NONFERROUS FOUNDRY
1983 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	1162.	1162.	0.	0.	0.	0.	0.	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	328.	328.	0.	0.	0.	0.	0.	0.	0.	0.
ARKANSAS	VI	310.	310.	0.	0.	0.	0.	0.	0.	0.	0.
CALIFORNIA	IX	7384.	7384.	0.	0.	0.	0.	0.	0.	0.	0.
COLORADO	VIII	157.	157.	0.	0.	0.	0.	0.	0.	0.	0.
CONNECTICUT	I	3497.	3497.	0.	0.	0.	0.	0.	0.	0.	0.
DELAWARE	III	544.	544.	0.	0.	0.	0.	0.	0.	0.	0.
FLORIDA	IV	1895.	1895.	0.	0.	0.	0.	0.	0.	0.	0.
GEORGIA	IV	2207.	2207.	0.	0.	0.	0.	0.	0.	0.	0.
HAWAII	IX	49.	49.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	9807.	9807.	0.	0.	0.	0.	0.	0.	0.	0.
INDIANA	V	3645.	3645.	0.	0.	0.	0.	0.	0.	0.	0.
IOWA	VII	1453.	1453.	0.	0.	0.	0.	0.	0.	0.	0.
KANSAS	VII	1071.	1071.	0.	0.	0.	0.	0.	0.	0.	0.
KENTUCKY	IV	842.	842.	0.	0.	0.	0.	0.	0.	0.	0.
LOUISIANA	VI	575.	575.	0.	0.	0.	0.	0.	0.	0.	0.
MAINE	I	432.	432.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	2008.	2008.	0.	0.	0.	0.	0.	0.	0.	0.
MASSACHUSETTS	I	10715.	10715.	0.	0.	0.	0.	0.	0.	0.	0.
MICHIGAN	V	3998.	3998.	0.	0.	0.	0.	0.	0.	0.	0.
MINNESOTA	V	1070.	1070.	0.	0.	0.	0.	0.	0.	0.	0.
MISSISSIPPI	IV	579.	579.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	804.	804.	0.	0.	0.	0.	0.	0.	0.	0.
MONTANA	VIII	48.	48.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	130.	130.	0.	0.	0.	0.	0.	0.	0.	0.
NEVADA	IX	49.	49.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	934.	934.	0.	0.	0.	0.	0.	0.	0.	0.
NEW JERSEY	II	7336.	7336.	0.	0.	0.	0.	0.	0.	0.	0.
NEW MEXICO	VI	49.	49.	0.	0.	0.	0.	0.	0.	0.	0.
NEW YORK	II	7072.	7072.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH CAROLINA	IV	7002.	7002.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH DAKOTA	VIII	85.	85.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	12278.	12278.	0.	0.	0.	0.	0.	0.	0.	0.
OKLAHOMA	VI	1084.	1084.	0.	0.	0.	0.	0.	0.	0.	0.
OREGON	X	1355.	1355.	0.	0.	0.	0.	0.	0.	0.	0.
PENNSYLVANIA	III	9874.	9874.	0.	0.	0.	0.	0.	0.	0.	0.
RHODE ISLAND	I	2524.	2524.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	5128.	5128.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH DAKOTA	VIII	85.	85.	0.	0.	0.	0.	0.	0.	0.	0.
TENNESSEE	IV	1615.	1615.	0.	0.	0.	0.	0.	0.	0.	0.
TEXAS	VI	2295.	2295.	0.	0.	0.	0.	0.	0.	0.	0.
UTAH	VIII	49.	49.	0.	0.	0.	0.	0.	0.	0.	0.
VERMONT	I	546.	546.	0.	0.	0.	0.	0.	0.	0.	0.
VIRGINIA	III	1031.	1031.	0.	0.	0.	0.	0.	0.	0.	0.
WASHINGTON	X	2175.	2175.	0.	0.	0.	0.	0.	0.	0.	0.
WEST VIRGINIA	III	274.	274.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	5306.	5306.	0.	0.	0.	0.	0.	0.	0.	0.
WYOMING	VIII	150.	150.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS		123000.	123000.	0.	0.	0.	0.	0.	0.	0.	0.
REGION I		18648.	18648.	0.	0.	0.	0.	0.	0.	0.	0.
II		14408.	14408.	0.	0.	0.	0.	0.	0.	0.	0.
III		13731.	13731.	0.	0.	0.	0.	0.	0.	0.	0.
IV		20429.	20429.	0.	0.	0.	0.	0.	0.	0.	0.
V		36099.	36099.	0.	0.	0.	0.	0.	0.	0.	0.
VI		4331.	4331.	0.	0.	0.	0.	0.	0.	0.	0.
VII		3463.	3463.	0.	0.	0.	0.	0.	0.	0.	0.
VIII		570.	570.	0.	0.	0.	0.	0.	0.	0.	0.
IX		7792.	7792.	0.	0.	0.	0.	0.	0.	0.	0.
X		3529.	3529.	0.	0.	0.	0.	0.	0.	0.	0.

APPENDIX J

OFFICE, COMPUTING, AND ACCOUNTING MACHINERY MANUFACTURING (SIC 357)
PROCESS WASTE GENERATION FOR 1975, 1977, AND 1983
BY STATE AND EPA REGION

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — MACHINE SHOP
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	32.	21.	32.	21.	7.	1.3	.5	0.	0.	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	318.	204.	318.	204.	71.	12.4	4.9	0.	0.	112.
ARKANSAS	VI	1083.	694.	1083.	694.	243.	42.2	16.7	0.	0.	382.
CALIFORNIA	IX	6788.	4352.	6788.	4352.	1520.	264.7	104.4	0.	0.	2397.
COLORADO	VIII	1683.	1079.	1683.	1079.	377.	65.6	25.9	0.	0.	594.
CONNECTICUT	I	1591.	1020.	1591.	1020.	356.	62.1	24.5	0.	0.	562.
DELAWARE	III	614.	394.	614.	394.	138.	24.0	9.4	0.	0.	217.
FLORIDA	IV	762.	489.	762.	489.	171.	29.7	11.7	0.	0.	269.
GEORGIA	IV	59.	38.	59.	38.	13.	2.3	.9	0.	0.	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	1626.	1042.	1626.	1042.	364.	63.4	25.0	0.	0.	574.
INDIANA	V	803.	515.	803.	515.	180.	31.3	12.4	0.	0.	284.
IOWA	VII	42.	27.	42.	27.	9.	1.6	.6	0.	0.	15.
KANSAS	VII	358.	229.	358.	229.	80.	14.0	5.5	0.	0.	126.
KENTUCKY	IV	1515.	971.	1515.	971.	339.	59.1	23.3	0.	0.	535.
LOUISIANA	VI	16.	10.	16.	10.	4.	.6	.2	0.	0.	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	241.	154.	241.	154.	54.	9.4	3.7	0.	0.	85.
MASSACHUSETTS	I	3181.	2039.	3181.	2039.	712.	124.1	48.9	0.	0.	1123.
MICHIGAN	V	687.	441.	687.	441.	154.	26.8	10.6	0.	0.	243.
MINNESOTA	V	2918.	1871.	2918.	1871.	654.	113.8	44.9	0.	0.	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	81.	52.	81.	52.	18.	3.2	1.2	0.	0.	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	65.	42.	65.	42.	15.	2.5	1.0	0.	0.	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	303.	195.	303.	195.	68.	11.8	4.7	0.	0.	107.
NEW JERSEY	II	1277.	819.	1277.	819.	286.	49.8	19.6	0.	0.	451.
NEW MEXICO	VI	212.	136.	212.	136.	47.	8.3	3.3	0.	0.	75.
NEW YORK	II	5124.	3285.	5124.	3285.	1148.	199.8	78.8	0.	0.	1809.
NORTH CAROLINA	IV	723.	463.	723.	463.	162.	28.2	11.1	0.	0.	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	1219.	781.	1219.	781.	273.	47.5	18.8	0.	0.	430.
OKLAHOMA	VI	638.	409.	638.	409.	143.	24.9	9.8	0.	0.	225.
OREGON	X	171.	110.	171.	110.	38.	6.7	2.6	0.	0.	60.
PENNSYLVANIA	III	737.	473.	737.	473.	165.	28.7	11.3	0.	0.	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	257.	165.	257.	165.	57.	10.0	3.9	0.	0.	91.
SOUTH DAKOTA	VIII	125.	80.	125.	80.	28.	4.9	1.9	0.	0.	44.
TENNESSEE	IV	189.	121.	189.	121.	42.	7.4	2.9	0.	0.	67.
TEXAS	VI	1944.	1246.	1944.	1246.	435.	75.8	29.9	0.	0.	686.
UTAH	VIII	282.	181.	282.	181.	63.	11.0	4.3	0.	0.	99.
VERMONT	I	71.	46.	71.	46.	16.	2.8	1.1	0.	0.	25.
VIRGINIA	III	119.	76.	119.	76.	27.	4.6	1.8	0.	0.	42.
WASHINGTON	X	807.	517.	807.	517.	181.	31.5	12.4	0.	0.	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	217.	139.	217.	139.	49.	8.5	3.3	0.	0.	77.
WYOMING	VIII	121.	77.	121.	77.	27.	4.7	1.9	0.	0.	43.
TOTALS		39000.	25000.	39000.	25000.	8735.	1521.0	600.0	0.	0.	13769.
REGION I		5163.	3310.	5163.	3310.	1156.	201.4	79.4	0.	0.	1823.
II		6402.	4104.	6402.	4104.	1434.	249.7	98.5	0.	0.	2260.
III		1711.	1097.	1711.	1097.	383.	66.7	26.3	0.	0.	604.
IV		3536.	2267.	3536.	2267.	792.	137.9	54.4	0.	0.	1248.
V		7471.	4789.	7471.	4789.	1673.	291.4	114.9	0.	0.	2638.
VI		3112.	1995.	3112.	1995.	697.	121.4	47.9	0.	0.	1099.
VII		546.	350.	546.	350.	122.	21.3	8.4	0.	0.	193.
VIII		2381.	1526.	2381.	1526.	533.	92.9	36.6	0.	0.	841.
IX		7871.	5046.	7871.	5046.	1763.	307.0	121.1	0.	0.	2779.
X		807.	517.	807.	517.	181.	31.5	12.4	0.	0.	285.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION -- HEAT TREATING
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.) Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	5.	2.	5.	2.	0.	0.	1.7	.1	.0	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	51.	20.	51.	20.	0.	0.	17.2	1.3	.5	0.
ARKANSAS	VI	172.	69.	172.	69.	0.	0.	58.7	4.6	1.6	0.
CALIFORNIA	IX	1079.	432.	1079.	432.	0.	0.	368.0	28.7	10.1	0.
COLORADO	VIII	268.	107.	268.	107.	0.	0.	91.2	7.1	2.5	0.
CONNECTICUT	I	253.	101.	253.	101.	0.	0.	86.3	6.7	2.4	0.
DELAWARE	III	98.	39.	98.	39.	0.	0.	33.3	2.6	.9	0.
FLORIDA	IV	121.	48.	121.	48.	0.	0.	41.3	3.2	1.1	0.
GEORGIA	IV	9.	4.	9.	4.	0.	0.	3.2	.2	.1	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	259.	103.	259.	103.	0.	0.	88.1	6.9	2.4	0.
INDIANA	V	128.	51.	128.	51.	0.	0.	43.5	3.4	1.2	0.
IOWA	VII	7.	3.	7.	3.	0.	0.	2.3	.2	.1	0.
KANSAS	VII	57.	23.	57.	23.	0.	0.	19.4	1.5	.5	0.
KENTUCKY	IV	241.	96.	241.	96.	0.	0.	82.1	6.4	2.3	0.
LOUISIANA	VI	3.	1.	3.	1.	0.	0.	.9	.1	.0	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	38.	15.	38.	15.	0.	0.	13.0	1.0	.4	0.
MASSACHUSETTS	I	506.	202.	506.	202.	0.	0.	172.4	13.5	4.7	0.
MICHIGAN	V	109.	44.	109.	44.	0.	0.	37.3	2.9	1.0	0.
MINNESOTA	V	464.	186.	464.	186.	0.	0.	158.2	12.3	4.3	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	13.	5.	13.	5.	0.	0.	4.4	.3	.1	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	10.	4.	10.	4.	0.	0.	3.5	.3	.1	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	48.	19.	48.	19.	0.	0.	16.5	1.3	.5	0.
NEW JERSEY	II	203.	81.	203.	81.	0.	0.	69.2	5.4	1.9	0.
NEW MEXICO	VI	34.	13.	34.	13.	0.	0.	11.5	.9	.3	0.
NEW YORK	II	815.	326.	815.	326.	0.	0.	277.8	21.7	7.6	0.
NORTH CAROLINA	IV	115.	46.	115.	46.	0.	0.	39.2	3.1	1.1	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	194.	78.	194.	78.	0.	0.	66.1	5.2	1.8	0.
OKLAHOMA	VI	101.	41.	101.	41.	0.	0.	34.6	2.7	.9	0.
OREGON	X	27.	11.	27.	11.	0.	0.	9.3	.7	.3	0.
PENNSYLVANIA	III	117.	47.	117.	47.	0.	0.	40.0	3.1	1.1	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	41.	16.	41.	16.	0.	0.	13.9	1.1	.4	0.
SOUTH DAKOTA	VIII	20.	8.	20.	8.	0.	0.	6.8	.5	.2	0.
TENNESSEE	IV	30.	12.	30.	12.	0.	0.	10.2	.8	.3	0.
TEXAS	VI	309.	124.	309.	124.	0.	0.	105.4	8.2	2.9	0.
UTAH	VIII	45.	18.	45.	18.	0.	0.	15.3	1.2	.4	0.
VERMONT	I	11.	5.	11.	5.	0.	0.	3.9	.3	.1	0.
VIRGINIA	III	19.	8.	19.	8.	0.	0.	6.5	.5	.2	0.
WASHINGTON	X	128.	51.	128.	51.	0.	0.	43.7	3.4	1.2	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	34.	14.	34.	14.	0.	0.	11.8	.9	.3	0.
WYOMING	VIII	19.	8.	19.	8.	0.	0.	6.5	.5	.2	0.
TOTALS		6200.	2480.	6200.	2480.	0.	0.	2114.0	165.0	58.0	0.
REGION I		821.	328.	821.	328.	0.	0.	279.9	21.8	7.7	0.
II		1018.	407.	1018.	407.	0.	0.	347.0	27.1	9.5	0.
III		272.	109.	272.	109.	0.	0.	92.7	7.2	2.5	0.
IV		562.	225.	562.	225.	0.	0.	191.7	15.0	5.3	0.
V		1188.	475.	1188.	475.	0.	0.	405.0	31.6	11.1	0.
VI		495.	198.	495.	198.	0.	0.	168.7	13.2	4.6	0.
VII		87.	35.	87.	35.	0.	0.	29.6	2.3	.8	0.
VIII		379.	151.	379.	151.	0.	0.	129.1	10.1	3.5	0.
IX		1251.	501.	1251.	501.	0.	0.	426.7	33.3	11.7	0.
X		128.	51.	128.	51.	0.	0.	43.7	3.4	1.2	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION -- ELECTROPLATING
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.) Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	18.	7.	18.	7.	3.	.1	.1	.2	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	179.	68.	179.	68.	32.	1.4	1.4	1.9	0.	0.
ARKANSAS	VI	611.	233.	611.	233.	108.	4.8	4.7	6.3	0.	0.
CALIFORNIA	IX	3829.	1462.	3829.	1462.	676.	29.9	29.6	39.7	0.	0.
COLORADO	VIII	949.	362.	949.	362.	168.	7.4	7.3	9.8	0.	0.
CONNECTICUT	I	898.	343.	898.	343.	158.	7.0	6.9	9.3	0.	0.
DELAWARE	III	346.	132.	346.	132.	61.	2.7	2.7	3.6	0.	0.
FLORIDA	IV	430.	164.	430.	164.	76.	3.4	3.3	4.5	0.	0.
GEORGIA	IV	33.	13.	33.	13.	6.	.3	.3	.3	0.	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	917.	350.	917.	350.	162.	7.2	7.1	9.5	0.	0.
INDIANA	V	453.	173.	453.	173.	80.	3.5	3.5	4.7	0.	0.
IOWA	VII	24.	9.	24.	9.	4.	.2	.2	.2	0.	0.
KANSAS	VII	202.	77.	202.	77.	36.	1.6	1.6	2.1	0.	0.
KENTUCKY	IV	855.	326.	855.	326.	151.	6.7	6.6	8.9	0.	0.
LOUISIANA	VI	9.	3.	9.	3.	2.	.1	.1	.1	0.	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	136.	52.	136.	52.	24.	1.1	1.0	1.4	0.	0.
MASSACHUSETTS	I	1794.	685.	1794.	685.	317.	14.0	13.9	18.6	0.	0.
MICHIGAN	V	388.	148.	388.	148.	68.	3.0	3.0	4.0	0.	0.
MINNESOTA	V	1646.	629.	1646.	629.	290.	12.9	12.7	17.1	0.	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	46.	17.	46.	17.	8.	.4	.4	.5	0.	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	37.	14.	37.	14.	6.	.3	.3	.4	0.	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	171.	65.	171.	65.	30.	1.3	1.3	1.8	0.	0.
NEW JERSEY	II	720.	275.	720.	275.	127.	5.6	5.6	7.5	0.	0.
NEW MEXICO	VI	120.	46.	120.	46.	21.	.9	.9	1.2	0.	0.
NEW YORK	II	2891.	1104.	2891.	1104.	510.	22.6	22.3	30.0	0.	0.
NORTH CAROLINA	IV	408.	156.	408.	156.	72.	3.2	3.2	4.2	0.	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	688.	263.	688.	263.	121.	5.4	5.3	7.1	0.	0.
OKLAHOMA	VI	360.	137.	360.	137.	64.	2.8	2.8	3.7	0.	0.
OREGON	X	96.	37.	96.	37.	17.	.8	.7	1.0	0.	0.
PENNSYLVANIA	III	416.	159.	416.	159.	73.	3.3	3.2	4.3	0.	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	145.	55.	145.	55.	26.	1.1	1.1	1.5	0.	0.
SOUTH DAKOTA	VIII	70.	27.	70.	27.	12.	.6	.5	.7	0.	0.
TENNESSEE	IV	106.	41.	106.	41.	19.	.8	.8	1.1	0.	0.
TEXAS	VI	1097.	419.	1097.	419.	193.	8.6	8.5	11.4	0.	0.
UTAH	VIII	159.	61.	159.	61.	28.	1.2	1.2	1.6	0.	0.
VERMONT	I	40.	15.	40.	15.	7.	.3	.3	.4	0.	0.
VIRGINIA	III	67.	26.	67.	26.	12.	.5	.5	.7	0.	0.
WASHINGTON	X	455.	174.	455.	174.	80.	3.6	3.5	4.7	0.	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	122.	47.	122.	47.	22.	1.0	.9	1.3	0.	0.
WYOMING	VIII	68.	26.	68.	26.	12.	.5	.5	.7	0.	0.
TOTALS		22000.	8400.	22000.	8400.	3882.	172.0	170.0	228.0	0.	0.
REGION I		2913.	1112.	2913.	1112.	514.	22.8	22.5	30.2	0.	0.
II		3611.	1379.	3611.	1379.	637.	28.2	27.9	37.4	0.	0.
III		965.	368.	965.	368.	170.	7.5	7.5	10.0	0.	0.
IV		1995.	762.	1995.	762.	352.	15.6	15.4	20.7	0.	0.
V		4214.	1609.	4214.	1609.	744.	32.9	32.6	43.7	0.	0.
VI		1755.	670.	1755.	670.	310.	13.7	13.6	18.2	0.	0.
VII		308.	118.	308.	118.	54.	2.4	2.4	3.2	0.	0.
VIII		1343.	513.	1343.	513.	237.	10.5	10.4	13.9	0.	0.
IX		4440.	1695.	4440.	1695.	784.	34.7	34.3	46.0	0.	0.
X		455.	174.	455.	174.	80.	3.6	3.5	4.7	0.	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — COATING
1975 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	**EPA Region**	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	3.	2.	3.	2.	2.	.2	.0	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	29.	21.	29.	21.	16.	2.2	.0	0.	0.	0.
ARKANSAS	VI	97.	72.	97.	72.	54.	7.6	.1	0.	0.	0.
CALIFORNIA	IX	609.	453.	609.	453.	338.	47.7	.9	0.	0.	0.
COLORADO	VIII	151.	112.	151.	112.	84.	11.8	.2	0.	0.	0.
CONNECTICUT	I	143.	106.	143.	106.	79.	11.2	.2	0.	0.	0.
DELAWARE	III	55.	41.	55.	41.	31.	4.3	.1	0.	0.	0.
FLORIDA	IV	68.	51.	68.	51.	38.	5.4	.1	0.	0.	0.
GEORGIA	IV	5.	4.	5.	4.	3.	.4	.0	0.	0.	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	146.	108.	146.	108.	81.	11.4	.2	0.	0.	0.
INDIANA	V	72.	54.	72.	54.	40.	5.6	.1	0.	0.	0.
IOWA	VII	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
KANSAS	VII	32.	24.	32.	24.	18.	2.5	.0	0.	0.	0.
KENTUCKY	IV	136.	101.	136.	101.	75.	10.6	.2	0.	0.	0.
LOUISIANA	VI	1.	1.	1.	1.	1.	.1	.0	0.	0.	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	22.	16.	22.	16.	12.	1.7	.0	0.	0.	0.
MASSACHUSETTS	I	285.	212.	285.	212.	158.	22.3	.4	0.	0.	0.
MICHIGAN	V	62.	46.	62.	46.	34.	4.8	.1	0.	0.	0.
MINNESOTA	V	262.	195.	262.	195.	145.	20.5	.4	0.	0.	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	7.	5.	7.	5.	4.	.6	.0	0.	0.	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	6.	4.	6.	4.	3.	.5	.0	0.	0.	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	27.	20.	27.	20.	15.	2.1	.0	0.	0.	0.
NEW JERSEY	II	115.	85.	115.	85.	64.	9.0	.2	0.	0.	0.
NEW MEXICO	VI	19.	14.	19.	14.	11.	1.5	.0	0.	0.	0.
NEW YORK	II	460.	342.	460.	342.	255.	36.0	.7	0.	0.	0.
NORTH CAROLINA	IV	65.	48.	65.	48.	36.	5.1	.1	0.	0.	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	109.	81.	109.	81.	61.	8.6	.2	0.	0.	0.
OKLAHOMA	VI	57.	43.	57.	43.	32.	4.5	.1	0.	0.	0.
OREGON	X	15.	11.	15.	11.	9.	1.2	.0	0.	0.	0.
PENNSYLVANIA	III	66.	49.	66.	49.	37.	5.2	.1	0.	0.	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	23.	17.	23.	17.	13.	1.8	.0	0.	0.	0.
SOUTH DAKOTA	VIII	11.	8.	11.	8.	6.	.9	.0	0.	0.	0.
TENNESSEE	IV	17.	13.	17.	13.	9.	1.3	.0	0.	0.	0.
TEXAS	VI	174.	130.	174.	130.	97.	13.7	.2	0.	0.	0.
UTAH	VIII	25.	19.	25.	19.	14.	2.0	.0	0.	0.	0.
VERMONT	I	6.	5.	6.	5.	4.	.5	.0	0.	0.	0.
VIRGINIA	III	11.	8.	11.	8.	6.	.8	.0	0.	0.	0.
WASHINGTON	X	72.	54.	72.	54.	40.	5.7	.1	0.	0.	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	19.	14.	19.	14.	11.	1.5	.0	0.	0.	0.
WYOMING	VIII	11.	8.	11.	8.	6.	.8	.0	0.	0.	0.
TOTALS		3500.	2600.	3500.	2600.	1941.	274.0	5.0	0.	0.	0.
REGION I		463.	344.	463.	344.	257.	36.3	.7	0.	0.	0.
II		575.	427.	575.	427.	319.	45.0	.8	0.	0.	0.
III		154.	114.	154.	114.	85.	12.0	.2	0.	0.	0.
IV		317.	236.	317.	236.	176.	24.8	.5	0.	0.	0.
V		670.	498.	670.	498.	372.	52.5	1.0	0.	0.	0.
VI		279.	207.	279.	207.	155.	21.9	.4	0.	0.	0.
VII		49.	36.	49.	36.	27.	3.8	.1	0.	0.	0.
VIII		214.	159.	214.	159.	119.	16.7	.3	0.	0.	0.
IX		706.	525.	706.	525.	392.	55.3	1.0	0.	0.	0.
X		72.	54.	72.	54.	40.	5.7	.1	0.	.0.	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — FERROUS AND NONFERROUS FOUNDRY
1975 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	20.	20.	0.	0.	0.	0.	0.	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	196.	196.	0.	0.	0.	0.	0.	0.	0.	0.
ARKANSAS	VI	667.	667.	0.	0.	0.	0.	0.	0.	0.	0.
CALIFORNIA	IX	4177.	4177.	0.	0.	0.	0.	0.	0.	0.	0.
COLORADO	VIII	1036.	1036.	0.	0.	0.	0.	0.	0.	0.	0.
CONNECTICUT	I	979.	979.	0.	0.	0.	0.	0.	0.	0.	0.
DELAWARE	III	378.	378.	0.	0.	0.	0.	0.	0.	0.	0.
FLORIDA	IV	469.	469.	0.	0.	0.	0.	0.	0.	0.	0.
GEORGIA	IV	36.	36.	0.	0.	0.	0.	0.	0.	0.	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	1001.	1001.	0.	0.	0.	0.	0.	0.	0.	0.
INDIANA	V	494.	494.	0.	0.	0.	0.	0.	0.	0.	0.
IOWA	VII	26.	26.	0.	0.	0.	0.	0.	0.	0.	0.
KANSAS	VII	220.	220.	0.	0.	0.	0.	0.	0.	0.	0.
KENTUCKY	IV	932.	932.	0.	0.	0.	0.	0.	0.	0.	0.
LOUISIANA	VI	10.	10.	0.	0.	0.	0.	0.	0.	0.	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	148.	148.	0.	0.	0.	0.	0.	0.	0.	0.
MASSACHUSETTS	I	1958.	1958.	0.	0.	0.	0.	0.	0.	0.	0.
MICHIGAN	V	423.	423.	0.	0.	0.	0.	0.	0.	0.	0.
MINNESOTA	V	1796.	1796.	0.	0.	0.	0.	0.	0.	0.	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	50.	50.	0.	0.	0.	0.	0.	0.	0.	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	40.	40.	0.	0.	0.	0.	0.	0.	0.	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	187.	187.	0.	0.	0.	0.	0.	0.	0.	0.
NEW JERSEY	II	786.	786.	0.	0.	0.	0.	0.	0.	0.	0.
NEW MEXICO	VI	130.	130.	0.	0.	0.	0.	0.	0.	0.	0.
NEW YORK	II	3153.	3153.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH CAROLINA	IV	445.	445.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	750.	750.	0.	0.	0.	0.	0.	0.	0.	0.
OKLAHOMA	VI	393.	393.	0.	0.	0.	0.	0.	0.	0.	0.
OREGON	X	105.	105.	0.	0.	0.	0.	0.	0.	0.	0.
PENNSYLVANIA	III	454.	454.	0.	0.	0.	0.	0.	0.	0.	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	158.	158.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH DAKOTA	VIII	77.	77.	0.	0.	0.	0.	0.	0.	0.	0.
TENNESSEE	IV	116.	116.	0.	0.	0.	0.	0.	0.	0.	0.
TEXAS	VI	1196.	1196.	0.	0.	0.	0.	0.	0.	0.	0.
UTAH	VIII	173.	173.	0.	0.	0.	0.	0.	0.	0.	0.
VERMONT	I	44.	44.	0.	0.	0.	0.	0.	0.	0.	0.
VIRGINIA	III	73.	73.	0.	0.	0.	0.	0.	0.	0.	0.
WASHINGTON	X	496.	496.	0.	0.	0.	0.	0.	0.	0.	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	134.	134.	0.	0.	0.	0.	0.	0.	0.	0.
WYOMING	VIII	74.	74.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS		24000.	24000.	0.	0.	0.	0.	0.	0.	0.	0.
REGION I		3177.	3177.	0.	0.	0.	0.	0.	0.	0.	0.
II		3939.	3939.	0.	0.	0.	0.	0.	0.	0.	0.
III		1053.	1053.	0.	0.	0.	0.	0.	0.	0.	0.
IV		2176.	2176.	0.	0.	0.	0.	0.	0.	0.	0.
V		4598.	4598.	0.	0.	0.	0.	0.	0.	0.	0.
VI		1915.	1915.	0.	0.	0.	0.	0.	0.	0.	0.
VII		336.	336.	0.	0.	0.	0.	0.	0.	0.	0.
VIII		1465.	1465.	0.	0.	0.	0.	0.	0.	0.	0.
IX		4844.	4844.	0.	0.	0.	0.	0.	0.	0.	0.
X		496.	496.	0.	0.	0.	0.	0.	0.	0.	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — MACHINE SHOP
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste (Wet Wt.)	Total Waste (Dry Wt.)	Total Potentially Hazardous Waste (Wet Wt.)	Total Potentially Hazardous Waste (Dry Wt.)	Total Hazardous Constituents (Dry Wt.): Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	32.	21.	32.	21.	7.	1.3	.5	0.	0.	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	318.	204.	318.	204.	71.	12.4	4.9	0.	0.	112.
ARKANSAS	VI	1083.	694.	1083.	694.	243.	42.2	16.7	0.	0.	382.
CALIFORNIA	IX	6788.	4352.	6788.	4352.	1520.	264.7	104.4	0.	0.	2397.
COLORADO	VIII	1683.	1079.	1683.	1079.	377.	65.6	25.9	0.	0.	594.
CONNECTICUT	I	1591.	1020.	1591.	1020.	356.	62.1	24.5	0.	0.	562.
DELAWARE	III	614.	394.	614.	394.	138.	24.0	9.4	0.	0.	217.
FLORIDA	IV	762.	489.	762.	489.	171.	29.7	11.7	0.	0.	269.
GEORGIA	IV	59.	38.	59.	38.	13.	2.3	.9	0.	0.	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	1626.	1042.	1626.	1042.	364.	63.4	25.0	0.	0.	574.
INDIANA	V	803.	515.	803.	515.	180.	31.3	12.4	0.	0.	284.
IOWA	VII	42.	27.	42.	27.	9.	1.6	.6	0.	0.	15.
KANSAS	VII	358.	229.	358.	229.	80.	14.0	5.5	0.	0.	126.
KENTUCKY	IV	1515.	971.	1515.	971.	339.	59.1	23.3	0.	0.	535.
LOUISIANA	VI	16.	10.	16.	10.	4.	.6	.2	0.	0.	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	241.	154.	241.	154.	54.	9.4	3.7	0.	0.	85.
MASSACHUSETTS	I	3181.	2039.	3181.	2039.	712.	124.1	48.9	0.	0.	1123.
MICHIGAN	V	687.	441.	687.	441.	154.	26.8	10.6	0.	0.	243.
MINNESOTA	V	2918.	1871.	2918.	1871.	654.	113.8	44.9	0.	0.	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	81.	52.	81.	52.	18.	3.2	1.2	0.	0.	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	65.	42.	65.	42.	15.	2.5	1.0	0.	0.	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	303.	195.	303.	195.	68.	11.8	4.7	0.	0.	107.
NEW JERSEY	II	1277.	819.	1277.	819.	286.	49.8	19.6	0.	0.	451.
NEW MEXICO	VI	212.	136.	212.	136.	47.	8.3	3.3	0.	0.	75.
NEW YORK	II	5124.	3285.	5124.	3285.	1148.	199.8	78.8	0.	0.	1809.
NORTH CAROLINA	IV	723.	463.	723.	463.	162.	28.2	11.1	0.	0.	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	1219.	781.	1219.	781.	273.	47.5	18.8	0.	0.	430.
OKLAHOMA	VI	638.	409.	638.	409.	143.	24.9	9.8	0.	0.	225.
OREGON	X	171.	110.	171.	110.	38.	6.7	2.6	0.	0.	60.
PENNSYLVANIA	III	737.	473.	737.	473.	165.	28.7	11.3	0.	0.	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	257.	165.	257.	165.	57.	10.0	3.9	0.	0.	91.
SOUTH DAKOTA	VIII	125.	80.	125.	80.	28.	4.9	1.9	0.	0.	44.
TENNESSEE	IV	189.	121.	189.	121.	42.	7.4	2.9	0.	0.	67.
TEXAS	VI	1944.	1246.	1944.	1246.	435.	75.8	29.9	0.	0.	686.
UTAH	VIII	282.	181.	282.	181.	63.	11.0	4.3	0.	0.	99.
VERMONT	I	71.	46.	71.	46.	16.	2.8	1.1	0.	0.	25.
VIRGINIA	III	119.	76.	119.	76.	27.	4.6	1.8	0.	0.	42.
WASHINGTON	X	807.	517.	807.	517.	181.	31.5	12.4	0.	0.	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	217.	139.	217.	139.	49.	8.5	3.3	0.	0.	77.
WYOMING	VIII	121.	77.	121.	77.	27.	4.7	1.9	0.	0.	43.
TOTALS		39000.	25000.	39000.	25000	8735.	1521.0	600.0	0.	0.	13769.
REGION I		5163.	3310.	5163.	3310.	1156.	201.4	79.4	0.	0.	1823.
II		6402.	4104.	6402.	4104.	1434.	249.7	98.5	0.	0.	2260.
III		1711.	1097.	1711.	1097.	383.	66.7	26.3	0.	0.	604.
IV		3536.	2267.	3536.	2267.	792.	137.9	54.4	0.	0.	1248.
V		7471.	4789.	7471.	4789.	1673.	291.4	114.9	0.	0.	2638.
VI		3112.	1995.	3112.	1995.	697.	121.4	47.9	0.	0.	1099.
VII		546.	350.	546.	350.	122.	21.3	8.4	0.	0.	193.
VIII		2381.	1526.	2381.	1526.	533.	92.9	36.6	0.	0.	841.
IX		7871.	5046.	7871.	5046.	1763.	307.0	121.1	0.	0.	2779.
X		807.	517.	807.	517.	181.	31.5	12.4	0.	0.	285.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION -- HEAT TREATING
1977 State and EPA Region Totals
(kkg/year)

State	EPA Region	Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
		(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	5.	2.	5.	2.	0.	0.	1.7	.1	.0	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	51.	20.	51.	20.	0.	0.	17.2	1.3	.5	0.
ARKANSAS	VI	172.	69.	172.	69.	0.	0.	58.7	4.6	1.6	0.
CALIFORNIA	IX	1079.	432.	1079.	432.	0.	0.	368.0	28.7	10.1	0.
COLORADO	VIII	268.	107.	268.	107.	0.	0.	91.2	7.1	2.5	0.
CONNECTICUT	I	253.	101.	253.	101.	0.	0.	86.3	6.7	2.4	0.
DELAWARE	III	98.	39.	98.	39.	0.	0.	33.3	2.6	.9	0.
FLORIDA	IV	121.	48.	121.	48.	0.	0.	41.3	3.2	1.1	0.
GEORGIA	IV	9.	4.	9.	4.	0.	0.	3.2	.2	.1	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	259.	103.	259.	103.	0.	0.	88.1	6.9	2.4	0.
INDIANA	V	128.	51.	128.	51.	0.	0.	43.5	3.4	1.2	0.
IOWA	VII	7.	3.	7.	3.	0.	0.	2.3	.2	.1	0.
KANSAS	VII	57.	23.	57.	23.	0.	0.	19.4	1.5	.5	0.
KENTUCKY	IV	241.	96.	241.	96.	0.	0.	82.1	6.4	2.3	0.
LOUISIANA	VI	3.	1.	3.	1.	0.	0.	.9	.1	.0	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	38.	15.	38.	15.	0.	0.	13.0	1.0	.4	0.
MASSACHUSETTS	I	506.	202.	506.	202.	0.	0.	172.4	13.5	4.7	0.
MICHIGAN	V	109.	44.	109.	44.	0.	0.	37.3	2.9	1.0	0.
MINNESOTA	V	464.	186.	464.	186.	0.	0.	158.2	12.3	4.3	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	13.	5.	13.	5.	0.	0.	4.4	.3	.1	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	10.	4.	10.	4.	0.	0.	3.5	.3	.1	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	48.	19.	48.	19.	0.	0.	16.5	1.3	.5	0.
NEW JERSEY	II	203.	81.	203.	81.	0.	0.	69.2	5.4	1.9	0.
NEW MEXICO	VI	34.	13.	34.	13.	0.	0.	11.5	.9	.3	0.
NEW YORK	II	815.	326.	815.	326.	0.	0.	277.8	21.7	7.6	0.
NORTH CAROLINA	IV	115.	46.	115.	46.	0.	0.	39.2	3.1	1.1	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	194.	78.	194.	78.	0.	0.	66.1	5.2	1.8	0.
OKLAHOMA	VI	101.	41.	101.	41.	0.	0.	34.6	2.7	.9	0.
OREGON	X	27.	11.	27.	11.	0.	0.	9.3	.7	.3	0.
PENNSYLVANIA	III	117.	47.	117.	47.	0.	0.	40.0	3.1	1.1	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	41.	16.	41.	16.	0.	0.	13.9	1.1	.4	0.
SOUTH DAKOTA	VIII	20.	8.	20.	8.	0.	0.	6.8	.5	.2	0.
TENNESSEE	IV	30.	12.	30.	12.	0.	0.	10.2	.8	.3	0.
TEXAS	VI	309.	124.	309.	124.	0.	0.	105.4	8.2	2.9	0.
UTAH	VIII	45.	18.	45.	18.	0.	0.	15.3	1.2	.4	0.
VERMONT	I	11.	5.	11.	5.	0.	0.	3.9	.3	.1	0.
VIRGINIA	III	19.	8.	19.	8.	0.	0.	6.5	.5	.2	0.
WASHINGTON	X	128.	51.	128.	51.	0.	0.	43.7	3.4	1.2	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	34.	14.	34.	14.	0.	0.	11.8	.9	.3	0.
WYOMING	VIII	19.	8.	19.	8.	0.	0.	6.5	.5	.2	0.
TOTALS		6200.	2480.	6200.	2480.	0.	0.	2114.0	165.0	58.0	0.
REGION I		821.	328.	821.	328.	0.	0.	279.9	21.8	7.7	0.
II		1018.	407.	1018.	407.	0.	0.	347.0	27.1	9.5	0.
III		272.	109.	272.	109.	0.	0.	92.7	7.2	2.5	0.
IV		562.	225.	562.	225.	0.	0.	191.7	15.0	5.3	0.
V		1188.	475.	1188.	475.	0.	0.	405.0	31.6	11.1	0.
VI		495.	198.	495.	198.	0.	0.	168.7	13.2	4.6	0.
VII		87.	35.	87.	35.	0.	0.	29.6	2.3	.8	0.
VIII		379.	151.	379.	151.	0.	0.	129.1	10.1	3.5	0.
IX		1251.	501.	1251.	501.	0.	0.	426.7	33.3	11.7	0.
X		128.	51.	128.	51.	0.	0.	43.7	3.4	1.2	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION -- ELECTROPLATING
1977 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	18.	7.	18.	7.	3.	.1	.1	.2	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	179.	68.	179.	68.	32.	1.4	1.4	1.9	0.	0.
ARKANSAS	VI	611.	233.	611.	233.	108.	4.8	4.7	6.3	0.	0.
CALIFORNIA	IX	3829.	1462.	3829.	1462.	676.	29.9	29.6	39.7	0.	0.
COLORADO	VIII	949.	362.	949.	362.	168.	7.4	7.3	9.8	0.	0.
CONNECTICUT	I	898.	343.	898.	343.	158.	7.0	6.9	9.3	0.	0.
DELAWARE	III	346.	132.	346.	132.	61.	2.7	2.7	3.6	0.	0.
FLORIDA	IV	430.	164.	430.	164.	76.	3.4	3.3	4.5	0.	0.
GEORGIA	IV	33.	13.	33.	13.	6.	.3	.3	.3	0.	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	917.	350.	917.	350.	162.	7.2	7.1	9.5	0.	0.
INDIANA	V	453.	173.	453.	173.	80.	3.5	3.5	4.7	0.	0.
IOWA	VII	24.	9.	24.	9.	4.	.2	.2	.2	0.	0.
KANSAS	VII	202.	77.	202.	77.	36.	1.6	1.6	2.1	0.	0.
KENTUCKY	IV	855.	326.	855.	326.	151.	6.7	6.6	8.9	0.	0.
LOUISIANA	VI	9.	3.	9.	3.	2.	.1	.1	.1	0.	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	136.	52.	136.	52.	24.	1.1	1.0	1.4	0.	0.
MASSACHUSETTS	I	1794.	685.	1794.	685.	317.	14.0	13.9	18.6	0.	0.
MICHIGAN	V	388.	148.	388.	148.	68.	3.0	3.0	4.0	0.	0.
MINNESOTA	V	1646.	629.	1646.	629.	290.	12.9	12.7	17.1	0.	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	46.	17.	46.	17.	8.	.4	.4	.5	0.	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	37.	14.	37.	14.	6.	.3	.3	.4	0.	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	171.	65.	171.	65.	30.	1.3	1.3	1.8	0.	0.
NEW JERSEY	II	720.	275.	720.	275.	127.	5.6	5.6	7.5	0.	0.
NEW MEXICO	VI	120.	46.	120.	46.	21.	.9	.9	1.2	0.	0.
NEW YORK	II	2891.	1104.	2891.	1104.	510.	22.6	22.3	30.0	0.	0.
NORTH CAROLINA	IV	408.	156.	408.	156.	72.	3.2	3.2	4.2	0.	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	688.	263.	688.	263.	121.	5.4	5.3	7.1	0.	0.
OKLAHOMA	VI	360.	137.	360.	137.	64.	2.8	2.8	3.7	0.	0.
OREGON	X	96.	37.	96.	37.	17.	.8	.7	1.0	0.	0.
PENNSYLVANIA	III	416.	159.	416.	159.	73.	3.3	3.2	4.3	0.	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	145.	55.	145.	55.	26.	1.1	1.1	1.5	0.	0.
SOUTH DAKOTA	VIII	70.	27.	70.	27.	12.	.6	.5	.7	0.	0.
TENNESSEE	IV	106.	41.	106.	41.	19.	.8	.8	1.1	0.	0.
TEXAS	VI	1097.	419.	1097.	419.	193.	8.6	8.5	11.4	0.	0.
UTAH	VIII	159.	61.	159.	61.	28.	1.2	1.2	1.6	0.	0.
VERMONT	I	40.	15.	40.	15.	7.	.3	.3	.4	0.	0.
VIRGINIA	III	67.	26.	67.	26.	12.	.5	.5	.7	0.	0.
WASHINGTON	X	455.	174.	455.	174.	80.	3.6	3.5	4.7	0.	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	122.	47.	122.	47.	22.	1.0	.9	1.3	0.	0.
WYOMING	VIII	68.	26.	68.	26.	12.	.5	.5	.7	0.	0.
TOTALS		22000.	8400.	22000.	8400.	3882.	172.0	170.0	228.0	0.	0.
REGION I		2913.	1112.	2913.	1112.	514.	22.8	22.5	30.2	0.	0.
II		3611.	1379.	3611.	1379.	637.	28.2	27.9	37.4	0.	0.
III		965.	368.	965.	368.	170.	7.5	7.5	10.0	0.	0.
IV		1995.	762.	1995.	762.	352.	15.6	15.4	20.7	0.	0.
V		4214.	1609.	1214.	1609.	744.	32.9	32.6	43.7	0.	0.
VI		1755.	670.	755.	670.	310.	13.7	13.6	18.2	0.	0.
VII		308.	118.	308.	118.	54.	2.4	2.4	3.2	0.	0.
VIII		1343.	513.	1343.	513.	237.	10.5	10.4	13.9	0.	0.
IX		4440.	1695.	4440.	1695.	784.	34.7	34.3	46.0	0.	0.
X		455.	174.	455.	174.	80.	3.6	3.5	4.7	0.	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION -- COATING
1977 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	**EPA Region**	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	3.	2.	3.	2.	2.	.2	.0	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	29.	21.	29.	21.	16.	2.2	.0	0.	0.	0.
ARKANSAS	VI	97.	72.	97.	72.	54.	7.6	.1	0.	0.	0.
CALIFORNIA	IX	609.	453.	609.	453.	338.	47.7	.9	0.	0.	0.
COLORADO	VIII	151.	112.	151.	112.	84.	11.8	.2	0.	0.	0.
CONNECTICUT	I	143.	106.	143.	106.	79.	11.2	.2	0.	0.	0.
DELAWARE	III	55.	41.	55.	41.	31.	4.3	.1	0.	0.	0.
FLORIDA	IV	68.	51.	68.	51.	38.	5.4	.1	0.	0.	0.
GEORGIA	IV	5.	4.	5.	4.	3.	.4	.0	0.	0.	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	146.	108.	146.	108.	81.	11.4	.2	0.	0.	0.
INDIANA	V	72.	54.	72.	54.	40.	5.6	.1	0.	0.	0.
IOWA	VII	4.	3.	4.	3.	2.	.3	.0	0.	0.	0.
KANSAS	VII	32.	24.	32.	24.	18.	2.5	.0	0.	0.	0.
KENTUCKY	IV	136.	101.	136.	101.	75.	10.6	.2	0.	0.	0.
LOUISIANA	VI	1.	1.	1.	1.	1.	.1	.0	0.	0.	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	22.	16.	22.	16.	12.	1.7	.0	0.	0.	0.
MASSACHUSETTS	I	285.	212.	285.	212.	158.	22.3	.4	0.	0.	0.
MICHIGAN	V	62.	46.	62.	46.	34.	4.8	.1	0.	0.	0.
MINNESOTA	V	262.	195.	262.	195.	145.	20.5	.4	0.	0.	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	7.	5.	7.	5.	4.	.6	.0	0.	0.	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	6.	4.	6.	4.	3.	.5	.0	0.	0.	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	27.	20.	27.	20.	15.	2.1	.0	0.	0.	0.
NEW JERSEY	II	115.	85.	115.	85.	64.	9.0	.2	0.	0.	0.
NEW MEXICO	VI	19.	14.	19.	14.	11.	1.5	.0	0.	0.	0.
NEW YORK	II	460.	342.	460.	342.	255.	36.0	.7	0.	0.	0.
NORTH CAROLINA	IV	65.	48.	65.	48.	36.	5.1	.1	0.	0.	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	109.	81.	109.	81.	61.	8.6	.2	0.	0.	0.
OKLAHOMA	VI	57.	43.	57.	43.	32.	4.5	.1	0.	0.	0.
OREGON	X	15.	11.	15.	11.	9.	1.2	.0	0.	0.	0.
PENNSYLVANIA	III	66.	49.	66.	49.	37.	5.2	.1	0.	0.	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	23.	17.	23.	17.	13.	1.8	.0	0.	0.	0.
SOUTH DAKOTA	VIII	11.	8.	11.	8.	6.	.9	.0	0.	0.	0.
TENNESSEE	IV	17.	13.	17.	13.	9.	1.3	.0	0.	0.	0.
TEXAS	VI	174.	130.	174.	130.	97.	13.7	.2	0.	0.	0.
UTAH	VIII	25.	19.	25.	19.	14.	2.0	.0	0.	0.	0.
VERMONT	I	6.	5.	6.	5.	4.	.5	.0	0.	0.	0.
VIRGINIA	III	11.	8.	11.	8.	6.	.8	.0	0.	0.	0.
WASHINGTON	X	72.	54.	72.	54.	40.	5.7	.1	0.	0.	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	19.	14.	19.	14.	11.	1.5	.0	0.	0.	0.
WYOMING	VIII	11.	8.	11.	8.	6.	.8	.0	0.	0.	0.
TOTALS		3500.	2600.	3500.	2600.	1941.	274.0	5.0	0.	0.	0.
REGION I		463.	344.	463.	344.	257.	36.3	.7	0.	0.	0.
II		575.	427.	575.	427.	319.	45.0	.8	0.	0.	0.
III		154.	114.	154.	114.	85.	12.0	.2	0.	0.	0.
IV		317.	236.	317.	236.	176.	24.8	.5	0.	0.	0.
V		670.	498.	670.	498.	372.	52.5	1.0	0.	0.	0.
VI		279.	207.	279.	207.	155.	21.9	.4	0.	0.	0.
VII		49.	36	49.	36.	27.	3.8	.1	0.	0.	0.
VIII		214.	159.	214.	159.	119.	16.7	.3	0.	0.	0.
IX		706.	525.	706.	525.	392.	55.3	1.0	0.	0.	0.
X		72.	54.	72.	54.	40.	5.7	.1	0.	0.	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION -- FERROUS AND NONFERROUS FOUNDRY
1977 State and EPA Region Totals
(kkg/year)

				Total Potentially		Total Hazardous Constituents (Dry Wt.)					
	EPA	Total Waste		Hazardous Waste		Flammable	Heavy		Acids/Alkali		Sweepings &
State	Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Solvents	Metals	Oils	Solution	Cyanide	Grindings
ALABAMA	IV	18.	18.	0.	0.	0.	0.	0.	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	179.	179.	0.	0.	0.	0.	0.	0.	0.	0.
ARKANSAS	VI	611.	611.	0.	0.	0.	0.	0.	0.	0.	0.
CALIFORNIA	IX	3829.	3829.	0.	0.	0.	0.	0.	0.	0.	0.
COLORADO	VIII	949.	949.	0.	0.	0.	0.	0.	0.	0.	0.
CONNECTICUT	I	898.	898.	0.	0.	0.	0.	0.	0.	0.	0.
DELAWARE	III	346.	346.	0.	0.	0.	0.	0.	0.	0.	0.
FLORIDA	IV	430.	430.	0.	0.	0.	0.	0.	0.	0.	0.
GEORGIA	IV	33.	33.	0.	0.	0.	0.	0.	0.	0.	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	917.	917.	0.	0.	0.	0.	0.	0.	0.	0.
INDIANA	V	453.	453.	0.	0.	0.	0.	0.	0.	0.	0.
IOWA	VII	24.	24.	0.	0.	0.	0.	0.	0.	0.	0.
KANSAS	VII	202.	202.	0.	0.	0.	0.	0.	0.	0.	0.
KENTUCKY	IV	855.	855.	0.	0.	0.	0.	0.	0.	0.	0.
LOUISIANA	VI	9.	9.	0.	0.	0.	0.	0.	0.	0.	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	136.	136.	0.	0.	0.	0.	0.	0.	0.	0.
MASSACHUSETTS	I	1794.	1794.	0.	0.	0.	0.	0.	0.	0.	0.
MICHIGAN	V	388.	388.	0.	0.	0.	0.	0.	0.	0.	0.
MINNESOTA	V	1646.	1646.	0.	0.	0.	0.	0.	0.	0.	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	46.	46.	0.	0.	0.	0.	0.	0.	0.	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	37.	37.	0.	0.	0.	0.	0.	0.	0.	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	171.	171.	0.	0.	0.	0.	0.	0.	0.	0.
NEW JERSEY	II	720.	720.	0.	0.	0.	0.	0.	0.	0.	0.
NEW MEXICO	VI	120.	120.	0.	0.	0.	0.	0.	0.	0.	0.
NEW YORK	II	2891.	2891.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH CAROLINA	IV	408.	408.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	688.	688.	0.	0.	0.	0.	0.	0.	0.	0.
OKLAHOMA	VI	360.	360.	0.	0.	0.	0.	0.	0.	0.	0.
OREGON	X	96.	96.	0.	0.	0.	0.	0.	0.	0.	0.
PENNSYLVANIA	III	416.	416.	0.	0.	0.	0.	0.	0.	0.	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	145.	145.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH DAKOTA	VIII	70.	70.	0.	0.	0.	0.	0.	0.	0.	0.
TENNESSEE	IV	106.	106.	0.	0.	0.	0.	0.	0.	0.	0.
TEXAS	VI	1097.	1097.	0.	0.	0.	0.	0.	0.	0.	0.
UTAH	VIII	159.	159.	0.	0.	0.	0.	0.	0.	0.	0.
VERMONT	I	40.	40.	0.	0.	0.	0.	0.	0.	0.	0.
VIRGINIA	III	67.	67.	0.	0.	0.	0.	0.	0.	0.	0.
WASHINGTON	X	455.	455.	0.	0.	0.	0.	0.	0.	0.	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	122.	122.	0.	0.	0.	0.	0.	0.	0.	0.
WYOMING	VIII	68.	68.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS		22000.	22000.	0.	0.	0.	0.	0.	0.	0.	0.
REGION I		2913.	2913.	0.	0.	0.	0.	0.	0.	0.	0.
II		3611.	3611.	0.	0.	0.	0.	0.	0.	0.	0.
III		965.	965.	0.	0.	0.	0.	0.	0	0.	0.
IV		1995.	1995.	0.	0.	0.	0.	0.	0.	0.	0.
V		4214.	4214.	0.	0.	0.	0.	0.	0.	0.	0.
VI		1755.	1755.	0.	0.	0.	0.	0.	0.	0.	0.
VII		308.	308.	0.	0.	0.	0.	0.	0.	0.	0.
VIII		1343.	1343.	0.	0.	0.	0.	0.	0.	0.	0.
IX		4440.	4440.	0.	0.	0.	0.	0.	0.	0.	0.
X		455.	455.	0.	0.	0.	0.	0.	0.	0.	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — MACHINE SHOP
1983 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	72.	60.	60.	49.	7.	1.4	5.8	0.	.0	11.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	709.	595.	595.	481.	71.	13.5	57.1	0.	.0	112.
ARKANSAS	VI	2416.	2027.	2027.	1639.	243.	46.1	194.5	0.	.1	382.
CALIFORNIA	IX	15143.	12706.	12706.	10270.	1520.	289.1	1218.9	0.	.7	2397.
COLORADO	VIII	3754.	3150.	3150.	2546.	377.	71.7	302.2	0.	.2	594.
CONNECTICUT	I	3550.	2979.	2979.	2408.	356.	67.8	285.8	0.	.2	562.
DELAWARE	III	1370.	1150.	1150.	929.	138.	26.2	110.3	0.	.1	217.
FLORIDA	IV	1700.	1427.	1427.	1153.	171.	32.5	136.9	0.	.1	269.
GEORGIA	IV	131.	110.	110.	89.	13.	2.5	10.5	0.	.0	21.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	3628.	3044.	3044.	2460.	364.	69.3	292.0	0.	.2	574.
INDIANA	V	1792.	1503.	1503.	1215.	180.	34.2	144.2	0.	.1	284.
IOWA	VII	93.	78.	78.	63.	9.	1.8	7.5	0.	.0	15.
KANSAS	VII	798.	670.	670.	541.	80.	15.2	64.3	0.	.0	126.
KENTUCKY	IV	3380.	2836.	2836.	2292.	339.	64.5	272.0	0.	.2	535.
LOUISIANA	VI	35.	29.	29.	24.	4.	.7	2.8	0.	.0	6.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	537.	450.	450.	364.	54.	10.2	43.2	0.	.0	85.
MASSACHUSETTS	I	7096.	5954.	5954.	4812.	712.	135.5	571.2	0.	.3	1123.
MICHIGAN	V	1533.	1287.	1287.	1040.	154.	29.3	123.4	0.	.1	243.
MINNESOTA	V	6510.	5463.	5463.	4415.	654.	124.3	524.0	0.	.3	1030.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	181.	152.	152.	123.	18.	3.5	14.6	0.	.0	29.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	145.	122.	122.	98.	15.	2.8	11.7	0.	.0	23.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	677.	568.	568.	459.	68.	12.9	54.5	0.	.0	107.
NEW JERSEY	II	2849.	2391.	2391.	1932.	286.	54.4	229.3	0.	.1	451.
NEW MEXICO	VI	473.	397.	397.	321.	47.	9.0	38.1	0.	.0	75.
NEW YORK	II	11431.	9592.	9592.	7752.	1148.	218.2	920.1	0.	.5	1809.
NORTH CAROLINA	IV	1612.	1353.	1353.	1093.	162.	30.8	129.8	0.	.1	255.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	2719.	2282.	2282.	1844.	273.	51.9	218.9	0.	.1	430.
OKLAHOMA	VI	1423.	1194.	1194.	965.	143.	27.2	114.6	0.	.1	225.
OREGON	X	381.	320.	320.	258.	38.	7.3	30.7	0.	.0	60.
PENNSYLVANIA	III	1644.	1380.	1380.	1115.	165.	31.4	132.4	0.	.1	260.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	573.	480.	480.	388.	57.	10.9	46.1	0.	.0	91.
SOUTH DAKOTA	VIII	278.	234.	234.	189.	28.	5.3	22.4	0.	.0	44.
TENNESSEE	IV	421.	353.	353.	286.	42.	8.0	33.9	0.	.0	67.
TEXAS	VI	4336.	3639.	3639.	2941.	435.	82.8	349.1	0.	.2	686.
UTAH	VIII	628.	527.	527.	426.	63.	12.0	50.6	0.	.0	99.
VERMONT	I	159.	134.	134.	108.	16.	3.0	12.8	0.	.0	25.
VIRGINIA	III	266.	223.	223.	180.	27.	5.1	21.4	0.	.0	42.
WASHINGTON	X	1800.	1510.	1510.	1221.	181.	34.4	144.9	0.	.1	285.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	484.	406.	406.	328.	49.	9.2	39.0	0.	.0	77.
WYOMING	VIII	270.	226.	226.	183.	27.	5.1	21.7	0.	.0	43.
TOTALS		87000.	73000.	73000.	59000.	8735.	1661.0	7003.0	0.	4.0	13769.
REGION I		11518.	9665.	9665.	7811.	1156.	219.9	927.1	0.	.5	1823.
II		14280.	11982.	11982.	9684.	1434.	272.6	1149.5	0.	.7	2260.
III		3817.	3202.	3202.	2588.	383.	72.9	307.2	0.	.2	604.
IV		7888.	6619.	6619.	5349.	792.	150.6	635.0	0.	.4	1248.
V		16666.	13984.	13984.	11302.	1673.	318.2	1341.5	0.	.8	2638.
VI		6942.	5825.	5825.	4708.	697.	132.5	558.8	0.	.3	1099.
VII		1218.	1022.	1022.	826.	122.	23.2	98.0	0.	.1	193.
VIII		5312.	4457.	4457.	3602.	533.	101.4	427.6	0.	.2	841.
IX		17559.	14734.	14734.	11908.	1763.	335.2	1413.4	0.	.8	2779.
X		1800.	1510.	1510.	1221.	181.	34.4	144.9	0.	.1	285.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — HEAT TREATING
1983 State and EPA Region Totals
(kkg/year)

				Total Potentially		Total Hazardous Constituents (Dry Wt.)					
	EPA	Total Waste		Hazardous Waste		Flammable	Heavy		Acids/Alkali		Sweepings &
State	Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Solvents	Metals	Oils	Solution	Cyanide	Grindings
ALABAMA	IV	16.	12.	10.	7.	0.	.0	6.7	.1	.5	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	155.	122.	98.	73.	0.	.2	66.0	1.2	5.3	0.
ARKANSAS	VI	528.	417.	333.	250.	0.	.7	225.0	4.2	18.1	0.
CALIFORNIA	IX	3307.	2611.	2089.	1567.	0.	4.4	1410.1	26.1	113.1	0.
COLORADO	VIII	820.	647.	518.	388.	0.	1.1	349.6	6.5	28.0	0.
CONNECTICUT	I	775.	612.	490.	367.	0.	1.0	330.6	6.1	26.5	0.
DELAWARE	III	299.	236.	189.	142.	0.	.4	127.6	2.4	10.2	0.
FLORIDA	IV	371.	293.	235.	176.	0.	.5	158.3	2.9	12.7	0.
GEORGIA	IV	29.	23.	18.	14.	0.	.0	12.2	.2	1.0	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	792.	625.	500.	375.	0.	1.0	337.8	6.3	27.1	0.
INDIANA	V	391.	309.	247.	185.	0.	.5	166.8	3.1	13.4	0.
IOWA	VII	20.	16.	13.	10.	0.	.0	8.7	.2	.7	0.
KANSAS	VII	174.	138.	110.	83.	0.	.2	74.3	1.4	6.0	0.
KENTUCKY	IV	738.	583.	466.	350.	0.	1.0	314.7	5.8	25.2	0.
LOUISIANA	VI	8.	6.	5.	4.	0.	.0	3.3	.1	.3	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	117.	93.	74.	56.	0.	.2	50.0	.9	4.0	0.
MASSACHUSETTS	I	1550.	1224.	979.	734.	0.	2.0	660.8	12.2	53.0	0.
MICHIGAN	V	335.	264.	212.	159.	0.	.4	142.8	2.6	11.5	0.
MINNESOTA	V	1422.	1122.	898.	673.	0.	1.9	606.2	11.2	48.6	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	40.	31.	25.	19.	0.	.1	16.9	.3	1.4	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	32.	25.	20.	15.	0.	.0	13.5	.3	1.1	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	148.	117.	93.	70.	0.	.2	63.0	1.2	5.1	0.
NEW JERSEY	II	622.	491.	393.	295.	0.	.8	265.3	4.9	21.3	0.
NEW MEXICO	VI	103.	82.	65.	49.	0.	.1	44.0	.8	3.5	0.
NEW YORK	II	2496.	1971.	1577.	1183.	0.	3.3	1064.4	19.7	85.4	0.
NORTH CAROLINA	IV	352.	278.	222.	167.	0.	.5	150.1	2.8	12.0	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	594.	469.	375.	281.	0.	.8	253.2	4.7	20.3	0.
OKLAHOMA	VI	311.	245.	196.	147.	0.	.4	132.5	2.5	10.6	0.
OREGON	X	83.	66.	53.	39.	0.	.1	35.5	.7	2.8	0.
PENNSYLVANIA	III	359.	284.	227.	170.	0.	.5	153.1	2.8	12.3	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	125.	99.	79.	59.	0.	.2	53.3	1.0	4.3	0.
SOUTH DAKOTA	VIII	61.	48.	38.	29.	0.	.1	25.9	.5	2.1	0.
TENNESSEE	IV	92.	73.	58.	44.	0.	.1	39.2	.7	3.1	0.
TEXAS	VI	947.	748.	598.	449.	0.	1.2	403.8	7.5	32.4	0.
UTAH	VIII	137.	108.	87.	65.	0.	.2	58.5	1.1	4.7	0.
VERMONT	I	35.	27.	22.	16.	0.	.0	14.9	.3	1.2	0.
VIRGINIA	III	58.	46.	37.	27.	0.	.1	24.7	.5	2.0	0.
WASHINGTON	X	393.	310.	248.	186.	0.	.5	167.6	3.1	13.4	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	106.	83.	67.	50.	0.	.1	45.1	.8	3.6	0.
WYOMING	VIII	59.	46.	37.	28.	0.	.1	25.1	.5	2.0	0.
TOTALS		19000.	15000.	12000.	9000.	0.	25.0	8101.0	150.0	650.0	0.
REGION I		2515.	1986.	1589.	1192.	0.	3.3	1072.5	19.9	86.1	0.
II		3119.	2462.	1970.	1477.	0.	4.1	1329.7	24.6	106.7	0.
III		833.	658.	526.	395.	0.	1.1	355.4	6.6	28.5	0.
IV		1723.	1360.	1088.	816.	0.	2.3	734.5	13.6	58.9	0.
V		3640.	2874.	2299.	1724.	0.	4.8	1551.9	28.7	124.5	0.
VI		1516.	1197.	957.	718.	0.	2.0	646.4	12.0	51.9	0.
VII		266.	210.	168.	126.	0.	.3	113.4	2.1	9.1	0.
VIII		1160.	916.	733.	549.	0.	1.5	494.6	9.2	39.7	0.
IX		3835.	3027.	2422.	1816.	0.	5.0	1635.1	30.3	131.2	0.
X		393.	310.	248.	186.	0.	.5	167.6	3.1	13.4	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — ELECTROPLATING
1983 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	25.	14.	19.	7.	3.	.2	.8	.2	.0	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	244.	139.	187.	73.	32.	2.2	8.3	1.9	.0	0.
ARKANSAS	VI	833.	472.	639.	250.	108.	7.6	28.2	6.3	.0	0.
CALIFORNIA	IX	5222.	2959.	4003.	1567.	676.	47.7	177.0	39.7	.2	0.
COLORADO	VIII	1295.	734.	993.	388.	168.	11.8	43.9	9.8	.0	0.
CONNECTICUT	I	1224.	694.	939.	367.	158.	11.2	41.5	9.3	.0	0.
DELAWARE	III	472.	268.	362.	142.	61.	4.3	16.0	3.6	.0	0.
FLORIDA	IV	586.	332.	449.	176.	76.	5.4	19.9	4.5	.0	0.
GEORGIA	IV	45.	26.	35.	14.	6.	.4	1.5	.3	.0	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	1251.	709.	959.	375.	162.	11.4	42.4	9.5	.0	0.
INDIANA	V	618.	350.	474.	185.	80.	5.6	20.9	4.7	.0	0.
IOWA	VII	32.	18.	25.	10.	4.	.3	1.1	.2	.0	0.
KANSAS	VII	275.	156.	211.	83.	36.	2.5	9.3	2.1	.0	0.
KENTUCKY	IV	1165.	660.	893.	350.	151.	10.6	39.5	8.9	.0	0.
LOUISIANA	VI	12.	7.	9.	4.	2.	.1	.4	.1	.0	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	185.	105.	142.	56.	24.	1.7	6.3	1.4	.0	0.
MASSACHUSETTS	I	2447.	1387.	1876.	734.	317.	22.3	83.0	18.6	.1	0.
MICHIGAN	V	529.	300.	405.	159.	68.	4.8	17.9	4.0	.0	0.
MINNESOTA	V	2245.	1272.	1721.	673.	290.	20.5	76.1	17.1	.1	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	62.	35.	48.	19.	8.	.6	2.1	.5	.0	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	50.	28.	38.	15.	6.	.5	1.7	.4	.0	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	233.	132.	179.	70.	30.	2.1	7.9	1.8	.0	0.
NEW JERSEY	II	982.	557.	753.	295.	127.	9.0	33.3	7.5	.0	0.
NEW MEXICO	VI	163.	92.	125.	49.	21.	1.5	5.5	1.2	.0	0.
NEW YORK	II	3942.	2234.	3022.	1183.	510.	36.0	133.6	30.0	.1	0.
NORTH CAROLINA	IV	556.	315.	426.	167.	72.	5.1	18.8	4.2	.0	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	938.	531.	719.	281.	121.	8.6	31.8	7.1	.0	0.
OKLAHOMA	VI	491.	278.	376.	147.	64.	4.5	16.6	3.7	.0	0.
OREGON	X	131.	74.	101.	39.	17.	1.2	4.5	1.0	.0	0.
PENNSYLVANIA	III	567.	321.	435.	170.	73.	5.2	19.2	4.3	.0	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	197.	112.	151.	59.	26.	1.8	6.7	1.5	.0	0.
SOUTH DAKOTA	VIII	96.	54.	74.	29.	12.	.9	3.3	.7	.0	0.
TENNESSEE	IV	145.	82.	111.	44.	19.	1.3	4.9	1.1	.0	0.
TEXAS	VI	1495.	847.	1146.	449.	193.	13.7	50.7	11.4	.0	0.
UTAH	VIII	217.	123.	166.	65.	28.	2.0	7.3	1.6	.0	0.
VERMONT	I	55.	31.	42.	16.	7.	.5	1.9	.4	.0	0.
VIRGINIA	III	92.	52.	70.	27.	12.	.8	3.1	.7	.0	0.
WASHINGTON	X	621.	352.	476.	186.	80.	5.7	21.0	4.7	.0	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	167.	95.	128.	50.	22.	1.5	5.7	1.3	.0	0.
WYOMING	VIII	93.	53.	71.	28.	12.	.8	3.2	.7	.0	0.
TOTALS		30000.	17000.	23000.	9000.	3882.	274.0	1017.0	228.0	1.0	0.
REGION I		3972.	2251.	3045.	1192.	514.	36.3	134.6	30.2	.1	0.
II		4924.	2790.	3775.	1477.	637.	45.0	166.9	37.4	.2	0.
III		1316.	746.	1009.	395.	170.	12.0	44.6	10.0	.0	0.
IV		2720.	1541.	2085.	816.	352.	24.8	92.2	20.7	.1	0.
V		5747.	3257.	4406.	1724.	744.	52.5	194.8	43.7	.2	0.
VI		2394.	1356.	1835.	718.	310.	21.9	81.1	18.2	.1	0.
VII		420.	238.	322.	126.	54.	3.8	14.2	3.2	.0	0.
VIII		1832.	1038.	1404.	549.	237.	16.7	62.1	13.9	.1	0.
IX		6055.	3431.	4642.	1816.	784.	55.3	205.3	46.0	.2	0.
X		621.	352.	476.	186.	80.	5.7	21.0	4.7	.0	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION -- COATING
1983 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	14.	13.	7.	7.	2.	.4	4.0	0.	.0	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	139.	130.	73.	65.	16.	4.0	39.4	0.	.1	0.
ARKANSAS	VI	472.	444.	250.	222.	54.	13.5	134.3	0.	.2	0.
CALIFORNIA	IX	2959.	2785.	1567.	1392.	338.	84.4	841.6	0.	1.6	0.
COLORADO	VIII	734.	690.	388.	345.	84.	20.9	208.6	0.	.4	0.
CONNECTICUT	I	694.	653.	367.	326.	79.	19.8	197.3	0.	.4	0.
DELAWARE	III	268.	252.	142.	126.	31.	7.6	76.1	0.	.1	0.
FLORIDA	IV	332.	313.	176.	156.	38.	9.5	94.5	0.	.2	0.
GEORGIA	IV	26.	24.	14.	12.	3.	.7	7.3	0.	.0	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	709.	667.	375.	334.	81.	20.2	201.6	0.	.4	0.
INDIANA	V	350.	330.	185.	165.	40.	10.0	99.6	0.	.2	0.
IOWA	VII	18.	17.	10.	9.	2.	.5	5.2	0.	.0	0.
KANSAS	VII	156.	147.	83.	73.	18.	4.4	44.4	0.	.1	0.
KENTUCKY	IV	660.	622.	350.	311.	75.	18.8	187.8	0.	.3	0.
LOUISIANA	VI	7.	6.	4.	3.	1.	.2	1.9	0.	.0	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	105.	99.	56.	49.	12.	3.0	29.8	0.	.1	0.
MASSACHUSETTS	I	1387.	1305.	734.	653.	158.	39.6	394.4	0.	.7	0.
MICHIGAN	V	300.	282.	159.	141.	34.	8.5	85.2	0.	.2	0.
MINNESOTA	V	1272.	1197.	673.	599.	145.	36.3	361.8	0.	.7	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	35.	33.	19.	17.	4.	1.0	10.1	0.	.0	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	28.	27.	15.	13.	3.	.8	8.1	0.	.0	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	132.	125.	70.	62.	15.	3.8	37.6	0.	.1	0.
NEW JERSEY	II	557.	524.	295.	2[illegible]2.	64.	15.9	158.3	0.	.3	0.
NEW MEXICO	VI	92.	87.	49.	43.	11.	2.6	26.3	0.	.0	0.
NEW YORK	II	2234.	2102.	1183.	1051.	255.	63.7	635.3	0.	1.2	0.
NORTH CAROLINA	IV	315.	297.	167.	148.	36.	9.0	89.6	0.	.2	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	531.	500.	281.	250.	61.	15.2	151.1	0.	.3	0.
OKLAHOMA	VI	278.	262.	147.	131.	32.	7.9	79.1	0.	.1	0.
OREGON	X	74.	70.	39.	35.	9.	2.1	21.2	0.	.0	0.
PENNSYLVANIA	III	321.	302.	170.	151.	37.	9.2	91.4	0.	.2	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	112.	105.	59.	53.	13.	3.2	31.8	0.	.1	0.
SOUTH DAKOTA	VIII	54.	51.	29.	26.	6.	1.6	15.5	0.	.0	0.
TENNESSEE	IV	82.	77.	44.	39.	9.	2.3	23.4	0.	.0	0.
TEXAS	VI	847.	798.	449.	399.	97.	24.2	241.0	0.	.4	0.
UTAH	VIII	123.	116.	65.	58.	14.	3.5	34.9	0.	.1	0.
VERMONT	I	31.	29.	16.	15.	4.	.9	8.9	0.	.0	0.
VIRGINIA	III	52.	49.	27.	24.	6.	1.5	14.8	0.	.0	0.
WASHINGTON	X	352.	331.	186.	165.	40.	10.0	100.0	0.	.2	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	95.	89.	50.	45.	11.	2.7	26.9	0.	.1	0.
WYOMING	VIII	53.	50.	28.	25.	6.	1.5	15.0	0.	.0	0.
TOTALS		17000.	16000.	9000.	8000.	1941.	485.0	4835.0	0.	9.0	0.
REGION I		2251.	2118.	1192.	1059.	257.	64.2	640.1	0.	1.2	0.
II		2790.	2626.	1477.	1313.	319.	79.6	793.6	0.	1.5	0.
III		746.	702.	395.	351.	85.	21.3	212.1	0.	.4	0.
IV		1541.	1451.	816.	725.	176.	44.0	438.4	0.	.8	0.
V		3257.	3065.	1724.	1533.	372.	92.9	926.2	0.	1.7	0.
VI		1356.	1277.	718.	638.	155.	38.7	385.8	0.	.7	0.
VII		238.	224.	126.	112.	27.	6.8	67.7	0.	.1	0.
VIII		1038.	977.	549.	488.	119.	29.6	295.2	0.	.5	0.
IX		3431.	3229.	1816.	1615.	392.	97.9	975.9	0.	1.8	0.
X		352.	331.	186.	165.	40.	10.0	100.0	0.	.2	0.

OFFICE, COMPUTING AND ACCOUNTING MACHINERY MANUFACTURING
SIC 357
PROCESS WASTE GENERATION — FERROUS AND NONFERROUS FOUNDRY
1983 State and EPA Region Totals
(kkg/year)

		Total Waste		Total Potentially Hazardous Waste		Total Hazardous Constituents (Dry Wt.)					
State	EPA Region	(Wet Wt.)	(Dry Wt.)	(Wet Wt.)	(Dry Wt.)	Flammable Solvents	Heavy Metals	Oils	Acids/Alkali Solution	Cyanide	Sweepings & Grindings
ALABAMA	IV	14.	14.	0.	0.	0.	0.	0.	0.	0.	0.
ALASKA	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ARIZONA	IX	139.	139.	0.	0.	0.	0.	0.	0.	0.	0.
ARKANSAS	VI	472.	472.	0.	0.	0.	0.	0.	0.	0.	0.
CALIFORNIA	IX	2959.	2959.	0.	0.	0.	0.	0.	0.	0.	0.
COLORADO	VIII	734.	734.	0.	0.	0.	0.	0.	0.	0.	0.
CONNECTICUT	I	694.	694.	0.	0.	0.	0.	0.	0.	0.	0.
DELAWARE	III	268.	268.	0.	0.	0.	0.	0.	0.	0.	0.
FLORIDA	IV	332.	332.	0.	0.	0.	0.	0.	0.	0.	0.
GEORGIA	IV	26.	26.	0.	0.	0.	0.	0.	0.	0.	0.
HAWAII	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
IDAHO	X	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ILLINOIS	V	709.	709.	0.	0.	0.	0.	0.	0.	0.	0.
INDIANA	V	350.	350.	0.	0.	0.	0.	0.	0.	0.	0.
IOWA	VII	18.	18.	0.	0.	0.	0.	0.	0.	0.	0.
KANSAS	VII	156.	156.	0.	0.	0.	0.	0.	0.	0.	0.
KENTUCKY	IV	660.	660.	0.	0.	0.	0.	0.	0.	0.	0.
LOUISIANA	VI	7.	7.	0.	0.	0.	0.	0.	0.	0.	0.
MAINE	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MARYLAND	III	105.	105.	0.	0.	0.	0.	0.	0.	0.	0.
MASSACHUSETTS	I	1387.	1387.	0.	0.	0.	0.	0.	0.	0.	0.
MICHIGAN	V	300.	300.	0.	0.	0.	0.	0.	0.	0.	0.
MINNESOTA	V	1272.	1272.	0.	0.	0.	0.	0.	0.	0.	0.
MISSISSIPPI	IV	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
MISSOURI	VII	35.	35.	0.	0.	0.	0.	0.	0.	0.	0.
MONTANA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEBRASKA	VII	28.	28.	0.	0.	0.	0.	0.	0.	0.	0.
NEVADA	IX	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NEW HAMPSHIRE	I	132.	132.	0.	0.	0.	0.	0.	0.	0.	0.
NEW JERSEY	II	557.	557.	0.	0.	0.	0.	0.	0.	0.	0.
NEW MEXICO	VI	92.	92.	0.	0.	0.	0.	0.	0.	0.	0.
NEW YORK	II	2234.	2234.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH CAROLINA	IV	315.	315.	0.	0.	0.	0.	0.	0.	0.	0.
NORTH DAKOTA	VIII	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OHIO	V	531.	531.	0.	0.	0.	0.	0.	0.	0.	0.
OKLAHOMA	VI	278.	278.	0.	0.	0.	0.	0.	0.	0.	0.
OREGON	X	74.	74.	0.	0.	0.	0.	0.	0.	0.	0.
PENNSYLVANIA	III	321.	321.	0.	0.	0.	0.	0.	0.	0.	0.
RHODE ISLAND	I	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH CAROLINA	IV	112.	112.	0.	0.	0.	0.	0.	0.	0.	0.
SOUTH DAKOTA	VIII	54.	54.	0.	0.	0.	0.	0.	0.	0.	0.
TENNESSEE	IV	82.	82.	0.	0.	0.	0.	0.	0.	0.	0.
TEXAS	VI	847.	847.	0.	0.	0.	0.	0.	0.	0.	0.
UTAH	VIII	123.	123.	0.	0.	0.	0.	0.	0.	0.	0.
VERMONT	I	31.	31.	0.	0.	0.	0.	0.	0.	0.	0.
VIRGINIA	III	52.	52.	0.	0.	0.	0.	0.	0.	0.	0.
WASHINGTON	X	352.	352.	0.	0.	0.	0.	0.	0.	0.	0.
WEST VIRGINIA	III	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WISCONSIN	V	95.	95.	0.	0.	0.	0.	0.	0.	0.	0.
WYOMING	VIII	53.	53.	0.	0.	0.	0.	0.	0.	0.	0.
TOTALS		17000.	17000.	0.	0.	0.	0.	0.	0.	0.	0.
REGION I		2251.	2251.	0.	0.	0.	0.	0.	0.	0.	0.
II		2790.	2790.	0.	0.	0.	0.	0.	0.	0.	0.
III		746.	746.	0.	0.	0.	0.	0.	0.	0.	0.
IV		1541.	1541.	0.	0.	0.	0.	0.	0.	0.	0.
V		3257.	3257.	0.	0.	0.	0.	0.	0.	0.	0.
VI		1356.	1356.	0.	0.	0.	0.	0.	0.	0.	0.
VII		238.	238.	0.	0.	0.	0.	0.	0.	0.	0.
VIII		1038.	1038.	0.	0.	0.	0.	0.	0.	0.	0.
IX		3431.	3431.	0.	0.	0.	0.	0.	0.	0.	0.
X		352.	352.	0.	0.	0.	0.	0.	0.	0.	0.

APPENDIX K

PRIVATE WASTE CONTRACTORS AND SERVICE ORGANIZATIONS

	EPA Region	Type of Facility *
Wayne Disposal Inc. Yellow Mills Road Palmyra, N.Y.	II	L.F.
Walter Pulcini Route 31 Palmyra, N.Y. 14522	II	L.F.
Chem-Trol Pollution Services, Inc. P.O. Box 200 Model City, N.Y. 14107	II	L.F., I. **
Falk Metal 15 McArdle Rochester, N.Y.	II	M.R.
Snyder Richmond, Va.	III	L.F.
Smith Metal & Iron Richmond, Va.	III	M.R.
L. Lavetan & Sons 246 W. King York, Pa. 17405	III	M.R.
Flash Cleaning Service R.D. #1 Felton, Pa. 17322	III	***
Abrams Metal Co. 60th & Lindbergit Blvd. Philadelphia, Pa. 19142	III	M.R.

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* M.L.F. - Municipal landfill
L.F. - Landfill (type unknown)
I. - Incineration
S.R. - Solvent recovery
M.R. - Metal recovery
O.R. - Oil recovery
U. - Unknown

** Scientifically controlled landfill
*** Spreads oil on dirt roads

APPENDIX K - Cont'd

	EPA Region	Type of Facility
Dyna-Vac Dyna Kleen Service Co. 2707 Tregaron Ave. Jeffersontown, Ky. 40299	IV	L.F.
Factory Services, Inc. 624 Kennedy Road Lexington, Ky.	IV	L.F.
Tinsley Bros. Greenville, S.C.	IV	M.R.
Lexington Scrap Metal Co., Inc. 461 Angliana Ave. Lexington, Ky.	IV	M.R.
Bruce's Iron & Metal, Inc. 46045 York Road Gastonia, N.C.	IV	M.R.
Bill Schwartz, Inc. 525 N. Broad St. Gastonia, N.C.	IV	U.
Golden Strip Septic W. Bulter Ave. Mauldin, S.C.	IV	U.
Chem-Met Services, Inc. 18550 Allen Road Wyandotte, Mich.	V	L.F.
Dial Trucking Co. 14001 Haggerty Rd. Plymouth, Mich. 48170	V	L.F.
AAA Disposal Route 51 Rosco, Wisc.	V	L.F.
Atlas Disposal Minneapolis,,Minn.	V	L.F.

APPENDIX K - Cont'd

	EPA Region	Type of Facility
Industrial Waste Disposal Franklin, Ohio	V	L.F.
Ernest McDaniel Dayton, Ohio Area	V	L.F.
A & A Disposal Prairie Avenue Beloit, Wisc.	V	L.F.
Shobel Minneapolis, Minn.	V	L.F.
Browning Ferris, Inc. Rockford, Ill.	V	L.F.
Pollution Controls, Inc. R.R. No. 1, Box 238 Shakopee, Minn. 55379	V	L.F., I.
Interstate Pollution Control Co. Div. of Roto Rooter Peoples Ave. Rockford, Ill.	V	O.R., L.F., I
Sani-Trucking Rochester, Minn.	V	U.
Lloyd Bros. Wausau, Wisc.	V	U.
Clearing Disposal Inc. 5245 W. 38th Street Cicero, Ill.	V	U.
Solid Pollution Controls Inc. Minneapolis, Minn.	V	U.
Armstrong Cesspool Service 7100 - 93rd Avenue, N Brooklyn Park, Minn.	V	U.

APPENDIX K - Cont'd

	EPA Region	Type of Facility
Koogler Suburban Dayton, Ohio	V	I.
Seymour Manufacturing Co. Solvents Reclaiming Div. 500 N. Broadway Seymour, Ind. 47274	V	S.R., I.
Lake Disposal Clare, Mich.	V	M.L.F.
Systems Technology Corp. Baxter Rd., at Rt. 73 Franklin, Ohio 45005	V	O.R., I., S.R.
Eli Sepec Dayton, Ohio Area	V	S.R., O.R.
Union Scrap Iron & Metal 210 - 15th Avenue Minneapolis, Minn.	V	M.R.
Central Oil 14134 Southfield Rd. Southfield, Mich.	V	*
Pollution Controls Inc. P.O. Box 1350 El Dorado, Ark.	VI	L.F.
Continental Metals Texas	VI	M.R.
Robert Barns Ft. Worth, Texas	VI	M.L.F.
Yellow Barrel Co. Loveland, Colorado	VII	L.F.

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* Collect used oil; sell to rerefiners or used for road oiling.

APPENDIX K - Cont'd

	EPA Region	Type of Facility
Aero Oil Co. Denver, Colorado	VII	L.F.
Johnston Sanitation Co. Loveland, Colorado	VII	L.F.
Liss Metal Ft. Collins, Colo.	VII	M.R.
United Refined Corp. Denver Area	VII	M.R.
Eisenhaeuer Denver Area	VII	M.R.
Sabin Denver Area	VII	M.R.
Selrex Denver Area	VII	M.R.
Van Waters & Rogers Denver, Colorado	VIII	M.R.
Southern California Chemical Los Angeles Area	IX	L.F.

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